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A DICTIONARY  
OF  
CHEMICAL TERMS

BY  
JAMES F. COUCH  
CHEMIST; BUREAU OF ANIMAL INDUSTRY  
U. S. DEPT. OF AGRICULTURE  
WASHINGTON, D. C.



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## PREFACE.

This volume occupies a territory which is, at present, covered by no other book and is designed to serve the convenience of anyone who has occasion to read chemical literature. The broad extension of chemical activities into apparently unrelated lines combined with specialization of interests has resulted in a complex and scattered terminology. It is often difficult and, in many cases, all but impossible, even with the best of library facilities, to find a definition for many of the more recently introduced terms. Under such conditions it is not easy for the chemist to read intelligently chemical literature which is not rather closely related to his own narrow specialty.

To assist in removing some of these difficulties this dictionary is offered to the chemical profession. It has been attempted to make it practical rather than academic and no pains have been spared to insure its accuracy and completeness. It has been subjected to detailed criticism and revision by a number of specialists in varied lines and the whole has been carefully edited.

The treatment of the terms has been designed to lie somewhere between that of a standard English dictionary and that of an encyclopaedia; in most cases elementary terms have received more extended treatment than more advanced terms. Controversy has been avoided where possible; usually the commonly accepted definition has been given and, often, the conflicting views are stated. The author, however, does not wish to be understood as assuming the position of referee in any controversial matter treated, nor must the definitions be considered to represent his private opinion in all cases. The definition given is intended to represent the idea generally accepted by chemists at this time.

Although every effort has been made to insure accuracy and completeness some errors in details and in conceptions may have escaped detection. The author, therefore, invites the fullest con-

structive criticism from any reader in order that such errors may be eliminated in future editions.

The author desires to express his indebtedness to Dr. H. H. Custis, Mr. J. N. Taylor, Dr. L. T. Giltner, and Mr. A. V. Fuller, for valuable advice, suggestion, and criticism, without whose assistance and encouragement it would have been difficult to have brought this work to a successful conclusion.

J. F. C.

# A DICTIONARY OF CHEMICAL TERMS.

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## A.

**Absorption.** The imbibing or attracting into its mass of one substance by another so that the absorbed substance disappears physically. The phenomenon may be due either to molecular or chemical action but is distinct from "adsorption" which is characterized by surface tension and condensation.

**Absorption Apparatus.** Certain forms of apparatus which are used especially in gas analysis by means of which a portion of the sample under examination is absorbed and its quantity thus determined.

**Absorption of Gases.** (Invasion.) The solution of gases in liquids is termed absorption and, more recently, "invasion." Such solutions obey the laws of Dalton and Henry unless the dissolved gas reacts with the solvent or forms a constant-boiling mixture with it.

**Absorption of Light.** When a compound beam of light is passed through a certain medium one or more of the constituent rays may disappear so that the light which issues from the medium is of different composition from that which entered it. The rays which have disappeared are said to have been absorbed. The property of absorbing certain rays is characteristic of a large number of substances and appears to be a function of their constitutions.

**Absorption, Unilateral and Bilateral.** The degree of absorption varies with

the wave-length of the light. When the absorption increases or decreases steadily with the wave-length the condition is termed unilateral absorption; when, however, there occurs a minimum absorption in the spectrum with increased absorption on either side whether the wave-length increases or decreases the condition is termed bilateral absorption.

**Absorptiometer.** A graduated tube closed at one end used for the analysis of gases by introducing an absorbing agent and noting the decrease in volume of the contents of the tube. Often incorrectly termed an eudiometer.

**Absorptive Power, or Coefficient of Absorption.** A term used to denote the fraction of radiant energy incident to a surface which is transformed into heat. It varies with the wave-length of the radiation and the angle of incidence. The reciprocal term is reflective power.

**Acaulescent.** (bot.) Nearly or completely stemless.

**Acceleration.** The rate of change of the velocity of a chemical reaction. When the acceleration is positive the reaction is increasing, when negative the reaction is diminishing in velocity.

**Acceptor.** A substance which unites with the active oxygen produced during the oxidation of certain other sub-

stances which will not unite with oxygen in the absence of the acceptor.

**Acetals.** Dialkyl ethers of hypothetical glycols. These glycols, if they existed, would contain two hydroxyl groups attached to one carbon atom as occurs in chloral hydrate. Acetals are formed by the union of two alcohol molecules with one of an aldehyde.

**Acetimetry.** The process of determining the acetic acid strength of vinegar.

**Acetimeter.** An instrument for acetimetry.

**Acetenyl Group.** A name applied to the group  $\text{—C}\equiv\text{CH}$  when it occurs in organic compounds.

**Acetyl.** The important organic radical  $\text{CH}_3\text{CO—}$  derived from acetic acid.

**Acetylate.** } The act or process  
**Acetylyze.** } of introducing the  
**Acetylyzation.** } acetyl radical into  
 an organic compound usually accomplished by boiling the substance with acetyl chloride or even by merely boiling with acetic acid.

**Acetylene Series.** **Alkines.** Aliphatic hydrocarbons of the general formula  $\text{C}_n\text{H}_{2n-2}$  characterized by a triple carbon linkage due to their content of the methenyl radical,  $\text{:CH}$ . The name of the series is derived from that of the simplest member acetylene, and the name of each hydrocarbon is formed, according to the Geneva plan, by changing the "yl" termination of the alcohol radicals of like carbon content to "ine," e.g. alkyl—alkine, ethyl—ethine.

**Achene.** (bot.) A small fruit which is one celled, one seeded, dry, hard, and indehiscent.

**Acicular.** Needle-shaped; applied to crystals.

**Acid.** 1. Any substance which may ionize in solution to form hydrogen ions. 2. Any substance which contains hydrogen capable of being replaced by basic radicals. Acids are classified as monobasic, dibasic, tribasic, polybasic, etc., according to the number (one, two, three, many, etc.) of hydrogen atoms replaceable by bases contained in a molecule; as organic when the molecule contains carbon; as normal, if they are derived from nitrogen, phosphorus, arsenic, and antimony and contain three hydroxyl groups, e.g. ortho-phosphoric acid; as ortho, meta, or para, according to the location of the carboxyl group in relation to another substituent in a cyclic compound, or as ortho, meta, or pyro, according to the composition of the compound.

**Acid Anhydrides.** Compounds derived from the acids by the elimination of one or more molecules of water from one or more molecules of the acid. The corresponding acids may commonly be regenerated from them by the addition of water, the process being often accompanied by an evolution of heat. It is worthy of note that, in the early periods of chemical theory, the acid anhydrides were regarded as the true acids, e.g.  $\text{SO}_3$  was considered the formula of sulphuric acid.

**Acid Chlorides.** Substances produced by substituting chlorine for hydroxyl in acid molecules, e.g., acetyl chloride,  $\text{CH}_3\text{COCl}$ . Termed also "acyl chlorides."

**Acid Egg.** An egg-shaped vessel of wrought iron fitted with appropriate piping which is used in the manufacture of sulphuric acid to pump the acid to the towers. Compressed air is the motive power employed.

**Acids, Haloid.** Acids which contain no oxygen in the molecule but are composed of hydrogen and an halogen element. Obsoletely "hydracids."

**Acid Number.** A term used in the analysis of fats or waxes to designate the number of milligrams of potassium hydroxide required to neutralize the free fatty acids in one gram of substance. The determination is performed by titrating an alcoholic solution of the wax or fat with tenth or half-normal alkali using phenolphthalein as indicator.

**Acids, Oxygen.** Acids which contain oxygen in contradistinction to the haloid acids. Obsoletely "oxyacids."

**Acids, Pseudo.** Substances which exhibit Ionic Isomerism (q.v.). Various compounds containing the group  $-\text{NO}_2$  and which are neutral may become acid by the tautomeric change of the  $\text{NO}_2$  group to  $=\text{NO.OH}$  and exhibit the characteristic properties of acids.

**Acid Radicals.** 1. The portion of the acid molecule apart from the hydroxyl group. Thus,  $\text{NO}_2$  is the acid radical of nitric acid. 2. The anionic portion of an acid, i.e.  $\text{SO}_4''$ ,  $\text{Cl}'$ .

**Acids, Sulphonic.** An important class of organic acids characterized by content of the group  $-\text{SO}_3\text{OH}$ , the "sulphonic acid" group. They are formed by digesting certain hydrocarbons or other compounds with either concentrated or fuming sulphuric acid and react as acids. They are usually very soluble in water and alcohol and only slightly soluble in ether and non-oxygenated solvents.

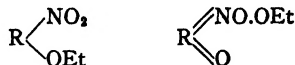
**Acidimeter.** (Obs.) A term formerly applied to a form of hydrometer used to determine the specific gravity of acid liquids.

**Acidimetry.** The process of determining the amount of an acid present in a sample by titration against a standard alkaline solution. The volume of reagent necessary exactly to neutralize the acid solution measures the number of gram-molecules of acid present. (V. analysis.)

**Acidylate.** To acylate.

**Acidylation.** Acylation.

**Ac-Nitro Compounds.** The colored isomers of the true nitro compounds e.g.



True nitro (ester)    Aci-nitro (ester)  
Cf. Pseudo acids.

**Aciviny Alcohol.** The unsaturated ketols (q.v.).

**Actinium.** A radioactive element discovered by Debierne in 1899. It stands between Thorium and Radium in the genealogical table of active elements (Rutherford). Actinium has not yet been obtained in a pure enough condition for exact study.

**Actinometry.** The determination of the photo-chemical intensity of light.

**Actinometer.** An instrument for measuring the photo-chemical intensity of light by exposing to the vibrations some chemical system which is sensitive to the influence of light. The best known are: Draper's Chlorine-Hydrogen actinometer, Bunsen and Roscoe's Silver Chloride actinometer, the Mercury Oxalate actinometer, and the Electro-Chemical actinometer.

**Action, Intermolecular, Principle of.** In determining the constitution of molecules by studying their decomposition products it is assumed that

radicals found in the cleavage products occupy contiguous positions in the original substance. This principle applies in such cases as the resolution of atropine into tropine and tropic acid.

**Activity, Chemical.** See Affinity.

**Actor, The.** In coupled or sympathetic reactions, the substance which takes part in both primary and secondary reactions as distinguished from the "inductor" and the "acceptor," both of which take part in but one of the reactions.

**Aculeate.** (bot.) Prickly.

**Acuminate.** (bot.) Tapering at the end.

**Acyclic.** Not of cyclic or ring structure, as the aliphatic hydrocarbons.

**Acy.** A generic term used to designate organic acid radicals, e.g. acetyl, benzoyl, salicyl, etc. Cf. acylation.

**Acylamino Group.** The acylated amino portion of a molecule, as  $\text{NH} \cdot \text{CO} \cdot \text{CH}_3$ , which occurs in acetanilid.

**Acylation.** The process of introducing an acid radical into a compound. Acetylation, benzoylation, etc., are examples.

**Adapter. Adopter.** A piece of apparatus in the shape of a gradually narrowing tube, commonly bent in an obtuse angle, used to connect distillatory and other apparatus, as a condenser and receiver.

**Addition Reaction.** When two or more molecules react to produce but one product the reaction is termed "addition" or, less commonly, a synthetic reaction. The direct union of carbon and hydrogen to produce acetylene; or of sulphur and oxygen

to produce sulphur dioxide are addition reactions.

**Additive Properties.** Certain of the properties of the elements are independent of the state of combination in which the elements may find themselves or the other elements with which they may be associated. Such properties are termed additive and include the atomic mass, the characteristic colors of some elements in combination, e.g. chromium, or copper, the density and others.

**Adiabatic Elasticity.** *L'élasticité adiabatique dynamique.* A term invented by Hugoniot to express the change of elasticity of the medium which is propagating an explosion wave assuming that the medium is discontinuous in the vicinity of the wave.

**Adiabatic Process.** Any process conducted without evolution or absorption of heat by the system involved. Thus, the adiabatic expansion of a gas is a condition where the total heat change represents the energy lost by the gas in expanding.

**Adiactinic.** Not transmitting photochemically active rays.

**Adsorption.** A manifestation of surface energy in which gases or dissolved solids are condensed upon the surface of the liquid or solid which acts as the adsorbing agent. It is caused by the tendency of the adsorbing surface to reduce its surface area and heat is evolved in the process. Adsorption is directly proportional to the free surface of the agent; it increases with increased pressure and diminishes with rise of temperature but not proportionally. Instances of adsorption may be found in certain forms of dyeing, in the condensation of large volumes of gases (hydrogen, ammonia, etc.) by charcoal and the decolorizing of solutions by animal

charcoal. The separation of certain bitter principles from solution by filtering them through animal charcoal, and the quantitative "precipitation" of alkaloids from their solutions by means of colloidal aluminic silicate (Lloyd) are probably examples of adsorption.

**Aeolotropism.** The property possessed by certain solids (as crystals) and some liquids of exhibiting differences in the physical properties of a spherical portion of the body when it is tested in different directions. Cf. Isotropism.

**Affinity, Chemical.** Barchusen in 1698 proposed this term to name the attractive force between elements by means of which compounds may be formed. A more recent view (Gibbs. Helm.) is that affinity is the intensity factor of chemical energy, the capacity factor being the equivalent weight of the element. The affinity determines the course of reaction in a mixture where many reactions are possible. Also termed, chemical activity, avidity, intensity, or potential.

**Affinity, Residual.** (Potential valence.) The force which leads the components of a reaction to associate and so determines the final products of the system.

**Aggregation, State of.** A term used to denote the properties of a mass due to its physical condition, as solid, liquid, or gaseous.

**Aglycone.** The non-carbohydrate portion of a glucosidic molecule. See glucoside.

**Alate.** (bot.) Winged.

**Albumins.** (Albumens.) 1. A large class of organic substances intimately associated with the structure of living organisms of which they compose the protoplasm. See protein. 2. A class

of proteins distinguished by solubility in water, coagulation on heating, content of sulphur, etc.

**Albumin, Acid.** A modification of albumin which is insoluble in pure water but dissolves in dilute acids. A correlative modification, alkali albumin, is known.

**Albuminoid Ammonia.** Ammonia obtained by decomposition of albuminous material. The quantity present is utilized in water analysis to determine the percentage of organic nitrogen in the sample.

**Albumoses.** (Peptones.) The products obtained by the digestion of proteins with pepsin or dilute acids.

**Alchemy.** 1. Medieval chemistry. 2. A term applied to the ancient attempts to transmute the base metals into gold and silver and to prepare the panacea for all diseases or the elixir of life. The most famous alchemists were Geber, Albertus Magnus, Roger Bacon, Raymond Lully, Basil Valentine, Paracelsus, Libavius, and Glauber.

**Alcogel.** See colloidal solutions.

**Alcohol.** 1. The common name for ethyl alcohol (ethanol). 2. Any one of a class of organic substances derived from the aliphatic hydrocarbons by the substitution of one or more hydroxyl groups for an equal number of hydrogen atoms, except that in rare cases only and only where modifying constitutional influences are present two hydroxyl groups or more are never united to the same carbon atom. The alkyl residue of the alcohol may be farther substituted by aromatic nuclei, as in benzyl alcohol  $C_6H_5CH_2OH$ , thus forming the alcoholic derivatives of the carbocyclic series but the alcoholic hydroxyl can never be directly united to a carbon atom which is a member of the aromatic ring. The alcohols are named

according to the Geneva plan by the substitution of *ol* for the final *e* of the parent hydrocarbon name: i.e. ethane,—ethanol; propane,—propanol, and the number of hydroxyl groups is indicated by the insertion of numerical prefixes between the hydrocarbon root and the *ol* suffix: i.e. glycerin is propantriol, glycol is ethandiol. In more complicated cases the position of the alcoholic groups is designated by the arabic numerals placed before the name of the compound.

Alcohols are classified, 1st, according to their content of hydroxyl groups as *monatomic*, *dialomic*, *trialomic*, etc., or *monohydric*, *dihydric*, *trihydric*, etc., depending upon one, two, three, etc., hydroxyl groups of alcoholic character; 2nd, according to the environment of the carbon atom to which the alcoholic hydroxyl is united as *primary*, *secondary*, or *tertiary*. Primary alcohols are characterized by the grouping  $-\text{CH}_2\text{OH}$ ; secondary alcohols by  $:\text{CHOH}$ ; and tertiary alcohols by  $:\text{COH}$ . It is evident that some compounds may contain all of these groups at once and so do not fall under any single one of the above classifications.

**Alcohol Acids.** Organic compounds which contain alcoholic groups and either carboxyl or sulphonic acid radicals in the same molecule.

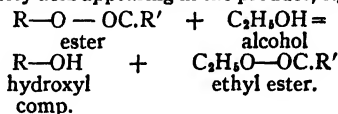
**Alcohols, Ketone.** Alcohols which contain the ketone (carbonyl) group.

**Alcoholic Fermentation.** The process of converting certain sugars, notably dextrose and fructose, into ethyl alcohol through the action of an enzyme or a ferment. The most common ferments used are the yeasts.

**Alcoholometer.** A form of hydrometer graduated in percentages of absolute alcohol or in degrees of proof spirit or both, used to determine the alcoholic strength of mixtures of alco-

hol and water and commonly referred to a definite temperature,  $15.6^\circ \text{C}$ . or  $60^\circ \text{F}$ . Some forms of the instrument are equipped with a thermometer and table of corrections so that the reading at any temperature may be reduced to that at  $15.6^\circ \text{C}$ .

**Alcoholysis.** A process analogous to hydrolysis in which an ester (particularly a fat) is saponified by heating with a solution of hydrochloric acid in absolute alcohol, the ethyl ester of the fatty acid appearing in the product, e.g.



**Alcoholometry.** (Alcoholometry.) The process of determining the alcoholic content of a mixture.

**Alcosol.** See colloidal solutions.

**Aldehyde.** 1. Acetaldehyde. 2. Any one of a class of compounds derived from the primary alcohols by oxidation and characterized by the group  $-\text{CHO}$ . They are named, 1. from the corresponding acids by combining the root of the acid with the word aldehyde, e.g. formaldehyde, butaldehyde, and 2. according to the Geneva plan by substituting "al" for the final *e* in the name of the parent hydrocarbon, e.g. ethanal, butanal.

**Aldehydrol.** A hydrate existing in aqueous solutions of acetaldehyde.

**Aldol Condensation.** See under condensation.

**Aldohexoses.** A class of sugars which contain six carbon atoms and an aldehyde group; e.g. glucose, mannose.

**Aldopentoses.** A class of sugars which contain five carbon atoms and



an aldehyde group; e.g. arabinose, ribose.

**Aldoses.** A class of sugars belonging to the monosaccharose group and which contain an aldehyde group.

**Aldosides.** Compounds resulting from the union of aldoses and alcohols, phenols or other hydroxylated substances by the elimination of water. The true glucosides belong to this class as do also the mannosides, galactosides, rhamnosides, arabinosides, xylosides, etc.

**Alembic.** A form of retort with a removable cap and neck used by early chemists and alchemists.

**Alexins.** Antibodies supposed to exist in the blood of naturally immune animals.

**Alicyclic Nucleus.** An hydroaromatic ring.

**Aliphatic.** Fatty. A broad division of organic substances which includes the compounds derived from the hydrocarbons of the paraffin, olefin, acetylene, or other *open* chain series as distinguished from those which contain an aromatic nucleus.

**Aliquot Part.** A portion of a sample taken for analysis in such a manner that the quantity taken shall be a simple fraction of the whole quantity. Used in certain analyses where the bulk of the sample is inconveniently large for treatment as a whole or where more than one analysis is desired from one sample. The results obtained are calculated to the whole sample.

**Alkalescent.** Slightly alkaline.

**Alkali.** Any one of several caustic hydroxides characterized by ability to form soluble soaps with fatty acids, to restore color to litmus which has been reddened by acids, and to unite with

carbon dioxide to form soluble compounds. The alkalies are the hydroxides of potassium, sodium, lithium, caesium, rubidium, and ammonium.

**Alkalies, Fixed.** The carbonates of the alkaline metals.

**Alkalies, Vegetable.** The alkaloids.

**Alkali, Volatile.** Ammonia.

**Alkalimetry.** The process of determining the amount of an alkali present in a sample by titration against a standard acid solution. The volume of reagent necessary exactly to neutralize the alkaline solution measures the number of gram-molecules of alkali present. (V. analysis.)

**Alkaline.** Exhibiting some or all of the properties of an alkali.

**Alkalinity.** A property characteristic of alkalies.

**Alkalize.** To render alkaline.

**Alkalization.** The act of communicating alkalinity to a compound or system.

**Alkaloid.** Any member of a class of organic compounds characterized by content of nitrogen and the property of combining with acids to form salts. The term is now limited to basic substances derived from plants and excludes the simpler amino derivatives, as aniline, quinoline, propylamine, etc., which were formerly included in the classification. Certain other substances, i.e. the purine bases, as caffeine, theobromine, etc., though products of vegetable organisms, are not now included among the alkaloids.

**Alkaloid, Cadaveric.** Ptomaines, q.v.

**Alkalines.** (Alcamines, alkines, or alcines.) Alcohols which contain an amido group, as amidobenzyl alcohol.

**Alkanes.** A generic term for the paraffin hydrocarbons proposed by A. W. Hofmann and retained by the Geneva Commission.

**Alkenes.** A generic term for the olefins.

**Alkines.** A generic term for the acetylenes.

**Alkoxy.** An organic group which may be designated  $R-O-$  in which  $R$  represents an alkyl radical. The methoxyl,  $CH_3-O-$ , and ethoxyl,  $C_2H_5-O-$ , groups are examples of alkoxy groups.

**Alkyl.** A generic name for any organic group or radical formed from an hydrocarbon by elimination of one atom of hydrogen and so producing a univalent unit. The term is usually restricted to those hypothetical radicals derived from the aliphatic hydrocarbons, those which owe their origin to the aromatic compounds being termed "aryl."

**Alkylogens.** The alkyl esters of the halogen acids, as ethyl chloride; they may also be regarded as the monohalogen substitution products of the aliphatic hydrocarbons, as monochloroethane.

**Allotropy.** The property by virtue of which, under certain conditions, a tautomeric substance is partly converted into its isomeric form and an equilibrium is established, the proportion of each isomer present depending upon the temperature, the solvent, and the degree of dilution.

**Allo-.** A prefix used to denote unexplained isomerism.

**Alloisomerism.** See Geometrical Isomerism.

**Allotrope.** One of the allotropic forms of an element.

**Allotropy.** (Allotropism.) The isomerism of the elements, (Richter). A property of certain elements by which they exist in two or more modifications distinct in physical, and some chemical, properties. In the case of oxygen, and probably of sulphur, the distinction is due to a difference in the number of atoms in the elementary molecule, and this may also explain the allotropic modifications of phosphorus and carbon. A good example of allotropy is furnished by carbon which exists in three forms, amorphous carbon or lampblack, graphite, and the diamond which differ in hardness, lustre, specific gravity, and heat of combustion.

It is worthy of note here that Ostwald considers allotropy merely a special case of polymorphism and suggests discarding the former term as there is no real reason for making the distinction.

**Allotropic Transformation.** The change from one allotropic form to another. It is commonly associated with a change in energy evidenced by absorption of heat and by occurring at a definite temperature,—the latter (a transition temperature) is only constant when both forms are stable.

**Allotropy, Dynamic.** A class of allotropic phenomena in which the transition from one form to another is reversible but where there is no definite transition temperature. The proportions of the allotropes depends upon the temperature.

**Allotropy, Enantiomorph.** A class of allotropic phenomena in which the transition from one form to another is reversible and takes place at a definite temperature above or below which only one form is stable, e.g. the alpha and beta forms of sulphur.

**Allotropy, Monotropic.** A class of allotropic phenomena in which the

transition is irreversible. One allotrope is metastable at all temperatures, e.g. explosive antimony.

**Alloy.** Any mixture or combination of metals formed by fusing the components together, as brass, bronze, type metal, etc. In practise the metal whose melting point is the highest is first fused and to it are then added the other constituents in the order of diminishing melting point. Where mercury is an ingredient the product is called an amalgam (q.v.). Alloys are to be regarded as mechanical mixtures of the metals rather than as compounds though often metallic compounds are present in the mixture and may crystallize out; some alloys are solid solutions of one metal or metallic compounds in another, others are mixtures of mutually insoluble metals. The melting point of an alloy is constant for a definite composition and is commonly lower than that of any of the constituents. Hydrogen and Ammonium may form alloys and so, may be regarded as metals.

**Alpha-.** ( $\alpha$ ) A prefix used to distinguish between isomers of nearly identical constitution, the others being termed beta, gamma, etc. as *alpha-naphthol* and *betanaphthol*; also applied to the position in the parent substance which the substituents may occupy to produce the isomeric compounds. These prefixes are also employed to distinguish between substances which occur together but whose constitutions are unknown, as the *alpha*, *beta*, and *gamma* resins of *cascara sagrada*.

**Alphyl.** An abbreviation for *alkyl-phenyl*, as  $\text{CH}_3\text{C}_6\text{H}_4$ — (*methylphenyl* or *toluyl*).

**Aludel.** A pear-shaped vessel open at both ends and arranged so that several of them may be fitted into one

another in succession to form a series. Used in the sublimation of iodine, the distillation of nitric acid, etc.

**Aluminium.** Metallic Element. Symbol Al; At. Wt. 27.1; Sp. Gr. 2.583; Sp. Heat, 0.2220; M.P.  $657^\circ\text{C}$ .; Valence 3; forms but one series of compounds; oxide  $\text{Al}_2\text{O}_3$ ; the hydroxide is amphoteric. Occurs naturally in the ruby and sapphire, as corundum, emery, various clays, feldspar, mica, cryolite, and most crystalline rocks.

**Alums.** A class of double salts of the general formula  $\text{M}_1'''(\text{SO}_4)_3\text{R}_1'\text{SO}_4 \cdot 24\text{H}_2\text{O}$ , in which M (say) may be any one of the three elements Aluminium, Iron, or Chromium, and R either potassium, sodium, caesium, lithium, rubidium, thallium, silver, or ammonium. They crystallize in octahedra or cubes and have many other properties in common. The name of the class is taken from common alum, potassium and aluminium sulphate,  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$ .

**Alums, Pseudo.** See pseudo alums.

**Amalgam.** Any alloy containing mercury. The amalgams are formed by dissolving other metals in mercury when combination takes place often with considerable evolution of heat. They are to be regarded as definite compounds of mercury with other metals or as solutions of such compounds in mercury and it has been shown that products which contain mercury and another metal in atomic proportions may be separated from amalgams.

**Amalgamation.** The process of forming an amalgam; applied in electrochemistry to the coating of electrodes with mercury and in metallurgy to a process for separating silver and gold from other metals or rocky material.

**Amasthenic.** (Amacritic.) *Photog.* A form of lens which focuses the actinic rays.

**Amic.** Derived from ammonia; especially the amic acids which are the amido derivatives of the inorganic acids; i.e. sulphamic acid,  $\text{HO.SO}_2\text{NH}_2$ , derived from sulphuric acid by the substitution of the amido for an hydroxyl group.

**Amicrons.** A name applied by Zsigmondy to individual disperse particles invisible under the ultramicroscope whose size is about  $10^{-7}$  cm. They act as nuclei for the formation of submicrons which are about five times as large.

**Amides.** A generic term for various organic compounds derived from ammonia by replacement of one or all of its three hydrogen atoms by radicals. The term is properly restricted to compounds which contain acyl residues; other substances should be referred to the class of amines but this strict classification is not always adhered to. 1. The acid amides are derived from ammonia by replacing hydrogen by acyl groups and are classified as *primary, secondary, or tertiary* as one, two, or three hydrogen atoms are replaced. *Mixed* amides may be formed by substituting, in primary or secondary amides, other acyl groups for the remaining ammoniacal hydrogen. 2. The amido acids, q.v. 3. Cyclic amides, vide Lactams.

**Amidines.** Derivatives of the amides in which the carbonyl oxygen is replaced by the imide group.

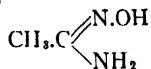
**Amido.** A prefix used to denote content of the group  $\text{NH}_2$  and more properly referred to in a majority of cases as "amino."

**Amido Acids.** A class of organic acids characterized by substitution of an amido group in the alkyl residue.

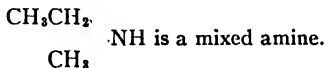
This distinguishes them from the true amides in which the amido group replaces hydroxyl in the carboxyl group. Amido acids are named from the parent acid and from the position of the amido group as *alpha, beta, gamma, delta*, etc., the greek letter being prefixed to the name of the compound. The count is begun with the first carbon atom of the alkyl residue and proceeds away from the carboxyl group. Thus  $\text{ClH}_2\text{NH}_2\text{CH}_2\text{CH}_2\text{COOH}$  is called  $\delta$ -amido-valeric acid. Called also amino acids.

**Amidogen.** An obsolete term for  $\text{NH}_2$ , especially in inorganic compounds.

**Amidoximes.** Compounds derived from the amidines by substitution of hydroxyl for an hydrogen atom of the amido or imido group, i.e. Ethenylamidoxime,



**Amines.** A class of organic compounds formed by substituting alkyl or aryl groups for the hydrogen atoms of ammonia. They are classified 1. as *primary, secondary, or tertiary* according to the number (one, two, or three) of hydrogen atoms so replaced, 2. as *simple or mixed*, in the cases of secondary and tertiary amines, if the substituents are all of the same or of different kinds of alkyls or aryls. Thus, methyl-amine,  $\text{CH}_3\text{NH}_2$ , is a primary amine; dimethyl-amine,  $(\text{CH}_3)_2\text{NH}$ , a secondary; trimethyl-amine,  $(\text{CH}_3)_3\text{N}$ , a tertiary, and methyl-ethyl-amine,



**Amino.** A prefix used to denote content of  $\text{NH}_2$ , the amino group, especially among aliphatic compounds not of acid nature. It is used inter-

changeably with "amido," the latter term being preferred, by many authors, for aromatic derivatives. Thus, aniline may be called amidobenzol, aminobenzol, or phenylamine.

**Aminolysis.** The conversion of diazoamido compounds into aminoazo compounds in the presence of a small amount of the hydrochloride of an aromatic base. Diazoamidobenzol,  $C_6H_5N_2NH.C_6H_5$ , thus rearranges to *p*-amidoazobenzol,  $C_6H_5N_2C_6H_4NH_2$ . In this rearrangement the azo nitrogen preferably enters in the para position to the amido group, but, when this is occupied,—as with the derivatives of *p*-toluidine,—the azo nitrogen will sometimes combine in the ortho position to the amido group. The velocity of the aminolysis is a function of the strength of the acid present.

**Ammeter.** An electrical instrument used to measure the strength of currents in amperes. It is usually a galvanometer provided with a scale which is graduated in amperes. The *milammeter* is an ammeter of great sensitivity and indicates the thousandth part of an ampere. The instrument is also called an amperometer and amperemeter.

**Ammines.** The metal-ammonium compounds, e.g. the cobaltammino salts, cuprammonium salts, etc.

**Ammino.** A combining term indicating content of the  $\text{NH}_2$  group in inorganic combination.

**Ammonia.** A compound of nitrogen and hydrogen,  $\text{NH}_3$ , the simplest member of the class of amines and the prototype of the organic bases.

**Ammonium.** The radical  $\text{NH}_4$ , which forms salts analogous to those of the alkaline metals.

**Ammonolysis.** A process analogous to hydrolysis in which ammonia

**reacts with a compound to form an amide and other products,**

$$\text{NaNH} : \text{NH}_2 + \text{NH}_3 \rightarrow \text{NaNH}_2$$

Na hydrazide                      sodamide  
  + NH<sub>3</sub> + N

**Amorphous.** Non-crystalline. Devoid of regular structure.

**Ampere.** The unit of electric current. One ampere delivers one coulomb in one second. The international ampere is defined as "the unvarying electric current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0.00111800 gram per second." The ampere is one-tenth of the c.g.s. unit of current.

**Amphi.** A prefix used to denote syn-anti isomerism of both kinds which occurs in certain dioximes. See isomerism syn-anti.

**Amphichroic.** A term applied to substances which exhibit two colors. (Obs.)

**Amphid.** Berzelius' term for salts produced by the combination of acids and bases or of two sulphides or oxides or selenides or tellurides to distinguish them from 'haloid' salts. Not now used.

**Amphoteric.** Capable of acting either as an acid or as a base according to the nature of the environment. Thus, aluminic hydroxide,  $\text{Al}(\text{OH})_3$ , dissolves in acids to form salts of aluminium and in solutions of strong bases to form aluminates, e.g. sodium aluminate,  $\text{NaAlO}_2$ . The term "isoelectric" is sometimes employed where amphoteric is meant.

**Amylolytic.** Any agent capable of hydrolyzing starches, particularly the enzyme diastase.

**Amylose.** A member of the starch group of carbohydrates; a polysaccharose.

**Analysis.** The resolution of a compound into its elements or atomic groups by chemical means. The correlative of synthesis. Various terms are applied to analytical processes employed for different purposes; they are described below.

**Analysis, Electro-.** A process of analysis wherein the electric current is used to effect the separation of the elements, as copper, nickel, cadmium, zinc, silver, etc., or by indicating differences in potential or conductivity to determine the amount of substance present.

**Analysis, Elementary.** Ultimate analysis.

**Analysis, Gas.** The process of analyzing a gaseous mixture or of determining a substance by causing an evolution of gas through a chemical reaction with the substance in question and measuring the volume of the gas so evolved.

**Analysis, Gravimetric.** See Analysis, quantitative.

**Analysis, Organic.** Ultimate analysis.

**Analysis, Proximate.** The separation into and determination of the classes of constituents of a mixture, usually applied to biological products, as plants. In this process no attempt is made to determine the elementary composition of the various constituents. Commonly the moisture, ash, alcohol extract, petroleum ether extract, water extract, hydrochloric acid extract, resins, starches, reducing sugars, albumens, free acids, esters, etc., are reported.

**Analysis, Qualitative.** The process of determining the nature of the various elements or simple compounds present in a mixture or compound without regard to the quantity of such

elements present. Taylor (A.J.P. 52.340) proposes the shortened form "*Qualitative*" Analysis.

**Analysis, Quantitative.** The process of determining the quantity of any or all elements present in a given compound or of the constituents of a mixture. Quantitative analysis may be *Gravimetric*, *Statmetric*, or *Volumetric*. Gravimetric processes depend upon the isolation of some product from the weight of which the proportion of desired element may be calculated; Volumetric analysis employs the process of Titration in which the proportion of element present is calculated from the volume of some standard reagent consumed by a reaction of which the desired element is a factor; Statmetric or Stathmetometric analysis employs the process of titration but the amount of standard reagent consumed is determined by weight, not by volume. Taylor (ref. above) proposed the term *quantitive* for quantitative.

**Analysis, Spectrum.** A method of analysis developed by Bunsen and Kirchhoff in 1859 in which the light emitted by glowing substances or from solutions is observed in a spectroscope and from the kind and position of bands in the spectrum there exhibited the nature of the component elements may be determined.

**Analysis, Ultimate.** Elementary organic analysis as distinguished from proximate analysis. Ultimate analysis is the process of determining the elementary composition of carbon compounds. Carbon is determined as carbon dioxide, hydrogen as water, nitrogen as free nitrogen, ammonia, or nitric acid, sulphur as barium sulphate, and the halogens as the corresponding silver salts.

**Analysis, Volumetric.** See Analysis, quantitative.

**Analyst.** One skilled in the methods and technique of chemical analysis.

**Analyzer.** 1. The Nicol prism situated in the eyepiece of a polariscope.  
2. The first tower of the Coffee still.

**Anelectrode.** The anode.

**Ångström.** The unit of wavelength, equal to  $10^{-7}$  mm.

**Anilides.** Compounds formed from aromatic amines by substitution of acyl groups for hydrogen in the amino group. Referred especially to those compounds formed from aniline, as acetanilid, but the term may be extended to include all of such substances.

**Anhydride.** A substance formed from another by the withdrawal of water and from which the first substance may be reformed by the addition of water. (V. acid anhydrides.)

**Anhydrous.** Not containing water in substance. Dry. Said of exsiccated salts, e.g. burnt alum. It is to be noted that sugar and other substances which contain oxygen and hydrogen in the proportions to form water may yet be anhydrous.

**Anions.** Substances which deposit on the anode. That portion of an electrolyte which carries the negative charge and travels against the conventional direction of the electric current in a cell. As anions are included all the non-metals and the acid radicals as well as the hydroxyl ion. In electrochemical reactions they are designated by a minus sign or an apostrophe placed above and behind the symbol, i.e.  $\text{Cl}^-$  or  $\text{Cl}'$ .

**Anionic Current.** That portion of the electric current carried by the anion.

**Annual.** (bot.) A plant which is of one year's duration, only.

**Anode.** The positive electrode of a cell. The electrode by which the current conventionally enters the cell. The electrode to which the anions travel and upon which they are deposited.

**Anther.** (bot.) The part of a stamen which carries the pollen.

**Antichlor.** A name applied to sodium thiosulphate or other substance used in removing the excess of chlorine in paper pulp or cloths after bleaching.

**Antidote.** Any substance used to counteract the noxious action of a poison when ingested into the animal organism. Antidotes may be mechanical, chemical, or physiological; mechanical when they cause emesis, chemical when they react with the poison to produce insoluble or harmless compounds, or physiological when they directly antagonize and neutralize the poison through the normal operation of the organism.

**Antimony.** Element. Symbol Sb (Stibium). At. Wt. 120.2, Sp. Gr. 6.62, Sp. Heat, 0.0495, M.P.  $630^\circ$ , B.P.  $1500-1700^\circ$ , Valences 3 and 5, Oxides  $\text{Sb}_2\text{O}_3$ ,  $\text{Sb}_2\text{O}_4$ ,  $\text{Sb}_2\text{O}_5$ ; it forms three series of compounds, the antimonious, antimonic, and acid compounds. Occurs naturally as sulphide, stibnite, and associated with other metals.

**Antipodes.** Enantiomorphs.

**Anti-bodies.** A term applied to those substances which inhibit the action of toxins or enzymes, as antitoxins, anti-enzymes.

**Anti-enzymes.** Substances analogous to the antitoxins which are produced by the organism following the injection of various enzymes into the blood. These anti-enzymes are able to inhibit the normal action of the enzymes from which they are formed to a remarkable extent and like the

anti-toxins are selective in their action. Anti-bodies for the following enzymes have been prepared; trypsin, pepsin, lipase, emulsin, urease, lactase, tyrosinase, thrombase, and rennin.

**Anti-syn Isomerism.** See isomerism syn-anti.

**Anti-toxins.** Substances produced by the organism following injection of toxin derived from pathogenic bacteria into the blood. These substances appear to combine with and neutralize the corresponding toxin and so immunize the organism against it but they are inactive towards other toxins. Ehrlich considers this as due to an asymmetric configuration so that only those anti-toxins which are constituted similarly to a certain toxin can unite with it. (See Danysz effect.)

**Antozone.** Schönbein's term for a hypothetical form of active oxygen.

**Antozonides.** Oxides produced by antozone, i.e. the peroxides of hydrogen, potassium, sodium, and others.

**Apetalous.** (bot.) Having no petals.

**Aporrhemas.** See ptomaines.

**Apparent Equilibrium.** When the velocity of a reaction is so small that it appears to remain unchanged with time it is in a state of apparent, but not of real, equilibrium. It differs from true equilibrium in that it is not reestablished automatically after the system has been disturbed.

**Aqua Ammonia.** The solution of ammonium hydroxide.

**Aqua Fortis.** Nitric acid.

**Aqua Regia.** A mixture of three to eight parts of hydrochloric with two of nitric acid. A solvent for gold.

**Aqua Tofana.** An arsenical solution of unknown composition em-

ployed by an Italian murderess Tofana in the 17th century. Some suppose it to have been merely an aqueous solution of arsenious oxide; others consider it more likely that it was an organic arsenic derivative.

**Aqua Vitae.** Brandy.

**Aquatic.** (bot.) Growing in water.

**Arconium.** (Arc.) An element assumed to exist in certain nebulae. At. Wt. calc. 2.9.

**Areometric Method.** The method of determining the specific gravity or specific volume of liquids by suspending in them a solid of known weight so arranged that it will float in the liquid and measuring the force required to sink the solid to a definite mark. The Westphal balance is commonly employed in this method.

**Argent.** Pertaining to or containing silver, especially in its form of highest oxidation.

**Argon.** Element. Symbol A, At. Wt. 39.98, Density (H-1) 19.96, Sp. Heat 0.1233, M.P. -187.9°, B.P. -186.1°, forms no known compounds. Argon is a constituent of the atmosphere of which it forms less than 1%.

**Aromatic Compounds.** (Carbocyclic compounds.) Substances derived from benzol,  $C_6H_6$ , and in which the benzene ring remains unaltered, as distinguished from the aliphatic compounds.

**Arsenic.** Element. Symbol As, At. Wt. 74.96, Mol. Wt.  $As_4$  299.84, exists in two allotropic forms: 1, Amorphous (microcrystalline?) S.G. 4.716, Sp. Heat 0.0758; 2, Crystalline, S.G. 5.727, Sp. Heat 0.0830, valence 3 and 5, forms arsenious, arsenic, and acid compounds. The arsenates are derived from arsenic acid,  $H_3AsO_4$ ; the arsenites from arsenious acid,  $H_3AsO_3$  (hypothetical); and the arsenides formed by the combination of



arsenic with the metals are analogous to the sulphides and phosphides.

**Artiads.** Those elements whose valence is an even number, 2, 4, or 6, as distinguished from the Perissads whose valence is numerically odd, 1, 3, or 5. The distinction has fallen into disuse.

**Aryl.** See Alkyl.

**Assay.** A form of analysis in which certain constituents of a mixture only are determined, the others being usually neglected. Applied particularly to minerals and drugs.

**Assay Ton.** A weight used in assaying ores containing precious metals in order to compensate the difference between the avoirdupois system (in which the ore is weighed) and the Troy system (in which gold and silver are weighed). The avoirdupois ton contains 29,166 Troy ounces and the assay ton is a weight of 29,166 mgm., so that each milligram of metal found per assay ton equals one Troy ounce per avoirdupois ton.

**Association.** 1. A phenomenon resembling polymerization, but not identical with it. Certain liquids (water, alcohol, benzol) appear to contain certain proportions of doubled, trebled, or polymultiplied molecules which are manifest by physical effects although chemically the liquid is a pure compound. The character of association is not well understood but it appears to be more in the nature of physical influence than of chemical combination (difference from polymerization). 2. The correlative of dissociation and ionization. 3. The uniting of the molecules of a substance in solution or in vapor at elevated temperatures to form complexes of several times the molecular weight of the parent compound. Sulphur and acetic acid associate to  $S_8$  and  $(C_2H_3O_2)_2$ . At higher temperature these

complexes split back to the normal molecule.

**Association Theory.** An attempt to explain the action of catalytic agents by assuming that the catalyst "associates" with one of the factors of the reaction and so alters the chemical equilibrium of the system that a reaction proceeds which would not occur in the absence of the catalyst.

**Asterium.** An element which appears to be present in some of the hotter stars and nebulae, unknown on the earth. Its existence is inferred from spectral evidence.

**Asymmetry.** Lack of symmetry in the spacial arrangement of the atoms and radicals within the molecule, especially of carbon compounds but also known with other elements. See Atoms, Isomerism.

**Asymmetry, Relative and Absolute.** Terms proposed by Baeyer to differentiate between the two forms of spacial isomerism known as *Optical* and *Geometrical* isomerism. Optical isomerism is considered absolute asymmetry, and Geometrical, relative asymmetry. See Isomerism.

**Atmo.** A unit of standard atmospheric pressure which may be defined as the pressure which will exactly balance a column of mercury 760 millimeters high at sea level under conditions of  $0^\circ$  C. and  $45^\circ$  latitude. (Obsolescent.)

**Atmosphere.** A more common name for the unit of atmospheric pressure defined under "Atmo."

**Atmolysis.** The separation of a mixture of gases by means of their relative diffusibility through a porous partition, as burned clay. The rates of diffusion are inversely as the square roots of the densities of the gases. Hydrogen, thus, is the most diffusible gas.

**Atom.** The smallest particle of an element which can enter into combination. All chemical compounds are formed of atoms, the difference between compounds being due to the nature, number, and arrangement of their constituent atoms. The atoms may or may not exist free; those of certain elements, e.g. the halogens, combine to form molecules of two atoms while the atoms of certain other elements appear to exist alone. According to the older chemical theory the atoms are indivisible and indestructible; recent investigations, especially of radioactive substances, cast doubt upon this view.

**Atomic Number.** A number which designates the place occupied in the periodic classification by the element to which it is affixed. The numbers begin with hydrogen (1) and proceed consecutively, vacancies due to unknown elements being numbered as if occupied.

**Atomics.** A name suggested for the science of pure chemistry as distinguished from physics and physical chemistry.

**Atoms, Asymmetric.** Atoms whose valences are saturated by different atoms or groups so that the resulting compounds are unsymmetrical and exhibit the phenomenon of optical activity. Asymmetric atoms must be at least trivalent according to the present view of stereochemical theory because the asymmetry is assumed to be due to the spacial arrangement of the atoms within the molecule in three dimensions. Carbon, Nitrogen, Silicon, Tin, Sulphur, and Selenium have been found to exist asymmetrically.

**Atoms, Barred.** (Double atoms.) A device adopted by Berzelius to adjust certain discrepancies between atomic weights and molecular formulas arising from the assumption that the oxides of the alkaline metals contain

one atom each of metal and oxygen instead of two of metal. A horizontal line was drawn through the symbol of the element to show that it was doubled. Thus  $\text{H}_2\text{O}$  became  $\text{H}\text{O}$ . This confusing system of notation was finally abandoned upon the revival of Avogadro's hypothesis and the consequent accurate determination of molecular weights.

**Atomic Theory.** } The assumption that matter is not infinitely divisible but is composed of ultimate particles called atoms. The hypothesis was enunciated by John Dalton in 1803 but the idea dates back to the Greek philosophers. Recent developments in chemistry have a tendency to contradict this hypothesis and, in using it, one must remember that it has never been proven.

**Atomic Volume.** The portion of space occupied by the elementary atom. A numerical relationship between the elements may be found by dividing the atomic weights by the specific gravities; the numbers so obtained are referred to as "atomic volumes" but the quantities are relative and not absolute.

**Atomic Weight.** The weight of an atom of any element, the weight of the oxygen atom being taken as 16. The absolute weights of the atoms are not known so an arbitrary standard has had to be established. As hydrogen is the lightest substance known, it was first taken as the standard and assigned the atomic weight 1. However, as oxygen combines with more elements than hydrogen, it is easier and more accurate to use it as a standard in determining atomic weights. The atomic weight is also called the equivalent weight and the relative weight.

**Atomicity.** 1. Valence. 2. Basicity. 3. The number of atoms in an elementary molecule.

**A'traction, Capillary.** See Surface Tension.

**Attraction, Chemical.** Chemical affinity.

**Attraction, Cohesion.** Adsorption. Molecular attraction (q.v.).

**Attraction, Gravitational.** That force which attracts any mass of matter to all other masses of matter. It is illustrated in the solar system by the attraction exerted by the sun upon the planets and by the individual planets upon each other. It varies directly with the product of the attracted masses and inversely as the square of the distance between them.

**Attraction, Magnetic.** A force exerted by a magnetized body upon another capable of magnetization, as of an iron magnet upon a piece of iron. The force exerted is directly proportional to the degree of magnetization of the attracting body and inversely proportional to the square of the distance between the magnet and attracted body. When magnetic attraction becomes negative it is termed "repulsion."

**Attraction, Molecular.** A force, analogous to gravitation, which exists between the molecules of a substance and causes adhesion, cohesion, and surface tension.

**Auric.** } Pertaining to the element  
**Aurous.** } gold. Compounds in  
**Aurum.** } which the element is uni-  
 valent are termed aurous; those con-  
 taining trivalent gold are termed auric.

**Autocatalysis.** A name given by Ostwald to the condition which obtains when one of the products of a reaction, or one of the factors, acts as a catalyst and so accelerates or retards the velocity of the reaction; e.g. in the hydrolysis of esters the acid products formed exert an influence to increase the velocity of the hydrolysis. Auto-

catalysis may be positive or negative according as the result of the catalytic action is acceleration or retardation.

**Autochemical Induction.** See Induced reactions.

**Autoclave.** A vessel in which substances may be heated under pressure.

**Autoracemization.** The spontaneous racemization of an optically active substance. See Racemization.

**Autoxidation.** The slow combustion or spontaneous oxidation of a substance in contact with oxygen; i.e. the oxidation of phosphorus, aldehyde, turpentine, etc. in the air. During the reaction part of the oxygen present is converted into ozone or hydrogen dioxide ("active oxygen"). The substance oxidized is termed the "autoxidizer" by Engler.

**Auxochrome.** A radical present in dyestuffs supposed to confer dyeing properties upon colored compounds which otherwise do not dye fibres. Auxochrome groups are "salt-forming," i.e. amido, hydroxyl, alkoxyl. See also Chromophore.

**Auxochromous Groups.** See above.

**Auxoflores.** Substituents which increase the intensity of the fluorescence exhibited by certain organic compounds, e.g. OH, NH<sub>2</sub>, CN, COOH.

**Auxogluc.** Any atom or group which may combine with a gluciphore to produce a sweet compound, e.g. hydrogen, the methyl, ethyl, propyl, isopropyl, etc. groups. See gluciphore.

**Avidity.** Affinity.

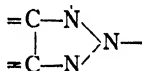
**Avogadro's Hypothesis.** (Avogadro's rule.) Avogadro, in 1811, enunciated the rule that equal volumes of gases under like conditions of temperature and pressure contain equal numbers of molecules. Upon this

assumption much of our chemical theory is based. The rule holds very true but is subject to slight modification to compensate the deviations from the gas law which gases show.

**Azides.** Compounds which contain the group  $\text{—CO.N}_3$ .

**Azimethylene Group.** The group  $\text{N} \begin{array}{c} \parallel \\ \text{N} \end{array} \text{C} =$  found in diazomethane, diazoacetic ester, etc.

**Azimides.** Compounds which contain the *Osootriazole* group,



**Azines.** Derivatives of a six-membered ring which contains nitrogen and either oxygen or sulphur as well as carbon atoms. The oxygen compounds are called "oxazines," the sulphur, "thiazines." Methylene blue is a thiazine derivative.

**Azo Compounds.** 1. Compounds which contain nitrogen (obs.). 2. Compounds which contain the azo group  $\text{—N:N—}$  united on either side to a benzene nucleus; as, azobenzene,  $\text{C}_6\text{H}_5\text{N:N—C}_6\text{H}_5$ , or to an aliphatic and an aromatic group, as benzene

azomethane,  $\text{C}_6\text{H}_5\text{—N:N—CH}_3$ . When the two nuclei are the same the compound is called "symmetrical," when dissimilar "unsymmetrical" and if one is aromatic and the other aliphatic, the compound is termed "mixed." Compounds which contain two or three azo groups are termed, "disazo" and "trisazo."

**Azocarbyls.** Löwig's term for substances which contain both carbon and nitrogen, as cyanogen. (Obs.)

**Azoimide Group.** The group



**Azoles.** Derivatives of a five-membered ring which contains nitrogen and either oxygen, sulphur, or an additional nitrogen atom, as well as carbon atoms.

**Azote.** The French term for nitrogen. Nitric and nitrous acids are in consequence respectively named *azotic* and *azotous* acids.

**Azotize.** To combine with nitrogen.

**Azotometer.** A nitrometer.

**Azoxy Compounds.** Substances

which contain the group  $\text{—N} \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \end{array} \text{N} \text{—}$ .

**Azylines.** The tetra alkyl derivatives of p-diamidoazobenzene.

## B.

**Bagasse.** The residue left after the sugar cane has been put through the roll-mills. It still contains about six per cent. or one-third of the total amount of sugar in the cane and this may be recovered by the "diffusion" process.

**Bain-Marie.** A water bath.

**Balance.** An instrument used for determining the weight of any substance. In its usual form it employs the principle of the lever, either of the first or second classes. Coarse forms of the instrument which are used for large weights are known as scales, the term balance being restricted to those of great sensitiveness used in analytical operations.

**Ball Mill.** A machine used for grinding solids, or for intimately mixing solids with solids or liquids. It consists of a spherical chamber mounted on a shaft and fitted with a tight cover; within are several heavy balls of iron, copper, lead, or stone. When the chamber is rotated the balls roll and tumble together, thus repeatedly pounding the substance into smaller particles. Almost any desired degree of fineness may be secured in the product.

**Balling Furnace.** (Black ash furnace.) A long reverberatory furnace equipped with two hearths used in the Leblanc process for soda. The pasty product is removed in balls, hence the name.

**Balsam.** An oleoresin obtained by incising the trunk of a tree or naturally exuding from it. Balsams contain

resins and essential oils in varying proportions among different members of the group. The best known are turpentine, balsam of Tolu, Peru balsam, and Canada balsam.

**Baric.** A salt containing barium as the basic radical.

**Barium.** Element. Ba. At. Wt. 137.37, Sp. Gr. 3.75, M. P. 850°, Valence 2, Oxide BaO. Forms but one series of compounds. Its soluble salts are very poisonous. Chiefly remarkable for the insolubility of its sulphate which requires 42,000 parts of water for solution. The color of barium is silver white.

**Barkometer.** An hydrometer graduated so as to read directly in terms of percentage of tanning material in a given solution.

**Barm.** Yeast, particularly that which floats upon the surface of fermentation fats and mixes with the foam.

**Barometer.** An instrument for measuring the pressure of the atmosphere. 1. The common mercury barometer consists of a column of mercury in an upright tube at least 80 cm. long from which the air has been exhausted; the upper end is sealed close while the lower dips into a cup containing mercury which is open to the air. The height of the mercury column in the tube indicates the air pressure. It was invented by Torricelli, of Florence, circa 1643. 2. The aneroid barometer consists of a thin disk of metal covering the aperture of a box from which the air has been

exhausted. Variation in atmospheric pressure causes a bulging of the disk which shifts a pointer over a scale and so indicates the pressures. It is less accurate than the mercury barometer but is more convenient to carry about.

**Barytic.** Pertaining to, or containing, barium.

**Barytum.** Obsolete name for barium.

**Barytes.** Heavy spar, a natural sulphate of barium. Extended to mean the oxide of barium (baryta) by old writers, as in the expression "sulphate of barytes."

**Base.** 1. A substance which ionizes in solution to form hydroxyl ions. 2. Any substance which has the property of neutralizing acids to form salts and which will restore the color of reddened litmus. 3. Any substance which can replace the hydrogen of an acid, or which contains hydroxyl groups capable of uniting with the hydrogen of an acid to form water and a salt, or which contains trivalent nitrogen and can add directly to an acid to produce a salt in which the nitrogen is pentavalent.

**Bases, Pseudo.** Non-basic substances which exhibit ionic isomerism. By a tautomeric change the hydroxyl of the carbinol group may migrate to the nitrogen atom in these compounds and so produce a strong, but labile, base. Cf. pseudo ammonium bases.

**Bases, Secondary.** Secondary

**Bases, Tertiary.** Tertiary amines.

**Basic.** Having the properties of a base.

**Basic Salts.** Salts which, on ionization, yield hydroxyl ions. They contain one or more molecules of base for one molecule of salt and are frequently spoken of as "sub" salts, as lead sub-

acetate or basic lead acetate, bismuth subnitrate, subcarbonate, etc.

**Basic Water.** In his electrochemical theory Berzelius considered that the acids were the oxides of the non-metallic elements and that, in their ordinary form, the acid liquids were hydrates of the true acids. Thus nitric acid was  $N_2O_5 \cdot H_2O$ , and a nitrate was formulated  $N_2O_5 \cdot K_2O$ . Inasmuch as water took the place of the base it was called "basic" water. The term died with the theory.

**Basicity.** The number of hydrogen atoms replaceable by a base possessed by an acid. The basicity of sulphuric acid is two, that of phosphoric acid three, etc.

**Basify.** To convert into a base, as to basify nitrobenzol by reducing it to aniline. (Rare.)

**Basylous.** Basic. (Obs.)

**Bath.** A medium for the transmission and regulation of heat to apparatus; sand, water, steam, and oil are the usual materials.

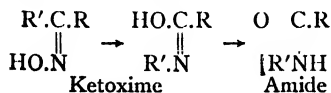
**Bath, Quickening.** A solution containing the cyanides of potassium and mercury used in electrochemistry to amalgamate the surface of articles intended to be silver plated.

**Bathochromic Groups.** The substitution of hydroxyl, alkyl, aryl, alkoxyl, carboxyl, or halogen groups into organic compounds causes a displacement of the bands in their absorption spectra towards the red end of the spectrum. Such groups are included in a generic term "bathochromic."

**Bathoflores.** (Bathofloric groups.) Substituents which decrease the intensity of the fluorescence exhibited by certain organic compounds. Nitro groups, halogens, methyl, etc., are bathoflores.

**Battery.** (Cell.) An apparatus for the transformation of chemical into electrical energy. Cells are classified as primary and secondary, primary if they furnish an electric current without previous action of electrical energy and secondary if they require previous electrical treatment, "charging." 1. Primary cells. (Galvanic or Voltaic batteries, elements.) These furnish electricity directly through the interaction of a metallic electrode and either an acid or a compound capable of furnishing anions. 2. Secondary batteries. (Storage batteries, accumulators.) Cells of peculiar construction in which the chemical reaction which, in the first place, generates the current may be reversed by the passage through the cell of a current in the direction opposite to that of the discharging current, the net result of which is to replace the cell in position to furnish electricity. If the proper conditions are maintained the process is exactly reversible, the number of coulombs delivered by the cell being exactly equal to the number expended in charging it, but in practise there is always a loss of energy.

**Beckmann Rearrangement, Change, or Reaction.** A reaction whereby ketoximes are converted into isomeric amides usually effected by treatment with phosphorus pentachloride but strong mineral acids may also be employed. The change occurs through entire rearrangement of the molecule: the hydroxyl group exchanges positions with the alkyl group in the cis position; then the hydroxyl hydrogen shifts to the nitrogen atom so that the double bond formerly between the nitrogen and carbonyl carbon is now found between the latter and the hydroxyl oxygen. It is represented



The reaction has been of particular service in determining the constitution of syn-anti isomers, for, from the acid formed by hydrolyzing the amide one can determine the radical anti to the oxime hydroxyl.

**Benzal.** (Benzylidene.) The radical  $\text{C}_6\text{H}_5\text{CH}$ :

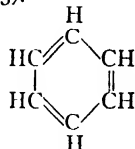
**Benzene.** (Benzol, Benzole.) The parent hydrocarbon of the aromatic series. Formula  $\text{C}_6\text{H}_6$ , Mol. Wt. 78.05, M. P.  $5.42^\circ$ , B. P.  $80.2^\circ$ . The chief characteristic of benzene is its cyclic structure. (V. Benzene, Theory, and Formulac.)

**Benzene of Crystallization.** Certain substances, particularly hydrocarbons, when crystallized from benzene retain a portion of the solvent in the same way that many salts crystallize from water with definite proportions of that solvent. Triphenylmethane crystallizes with one molecule of benzene.

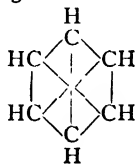
**Benzene, Formulae.** Many formulae have been advanced to represent the constitution of benzene and its derivatives but no one is free from objection. The more common formulae are presented below. For a very full discussion of them consult J. B. Cohen's "Organic Chemistry."

1. Plane formulae.

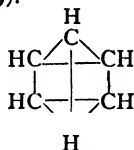
Kekulé (1865).



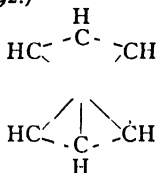
Claus. (Diagonal formula, 1867.)



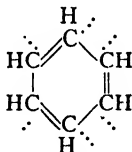
Claus. (Prism formula, 1867.) Ladenburg (1869).



Centric formula. (Armstrong, 1887, Baeyer, 1892.)

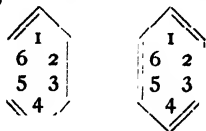


Thiele's "partial valency" formula. (1899.)



II. Space formulæ. Representing the six carbon atoms of benzene by six regular tetrahedrons arranged in various ways; spacial formulas have been advocated by Baeyer, Marsh, Vaubel, Sachse, and others. (Graebe, Ber. 35, 526.)

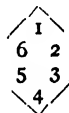
III. Dynamic formulæ. The Kekulé formula leads one to expect the formation of two ortho derivatives of benzene isomeric with each other, whereas this has never been observed. To account for this Kekulé advanced a dynamic hypothesis assuming an oscillation of the carbon atoms with shifting of the double bond from carbon 2 to carbon 6,



and simultaneous adjustment of the other atoms. Knoevenagel supposes each of the carbon atoms to rotate in an opposite direction to its neighbors, thus forming and breaking the double bond alternately. Knorr assumes an oscillation of the hydrogen atoms, and Collie supposes that the carbon atoms not only change their relative positions but rotate as a whole.

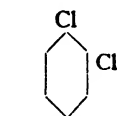
**Benzene Ring.** (Benzene Nucleus.)

A regular hexagon conventionally adopted to represent the molecular structure of the six carbon atoms in benzene and to denote the presence and relations of that compound in its derivatives. It is represented and the carbon atoms are numbered thus:



**Benzene Substitution Products, Nomenclature of.** All of the hydrogen atoms in benzene may be replaced by univalent atoms or groups forming mono-, di-, tri-, tetra-, penta-, or hexa-, derivatives according to the number of substituents. Two possibilities arise: 1. The substituents are all of one kind. Here we find but one modification of the mono-, penta-, and hexa-, derivatives and three of the di-, tri-, and tetra-derivatives. (a) The di-derivatives are named according to the relative positions which the substituents assume around the ring as ortho-, meta-, or para-; ortho-where adjacent carbon atoms are involved, meta- when an unsubstituted carbon rests between the two substituted carbons, and para- if two unsubstituted carbon atoms occur between the substituted carbons. Diagrammatically:





Ortho-dichlorobenzene.



Meta-dichlorobenzene.

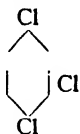


Para-dichlorobenzene.

(b) The tri-derivatives are named adjacent (vicinal), unsymmetrical (asymmetrical), and symmetrical according as the groups take up the positions (1, 2, 3), (1, 2, 4), or (1, 3, 5).



Vicinal trichlorobenzene.



Unsymmetrical trichlorobenzene.

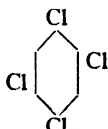


Symmetrical trichlorobenzene.

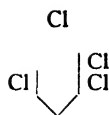
(c) The tetra-derivatives are named adjacent, symmetrical, or unsymmetrical according as the positions assumed by the substituents are (1, 2, 3, 4), (1, 2, 4, 5), or (1, 2, 3, 5).



Adjacent tetrachlorobenzene.

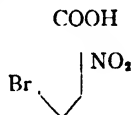


Symmetrical tetrachlorobenzene.



Unsymmetrical tetrachlorobenzene.

2. The substituents are of two or more kinds. Here the number of isomers is greatly multiplied. (a) The derivatives which contain two unlike substituents may be distinguished by the prefixes ortho-, meta-, and para-, as orthonitrochlorobenzene, or the positions of the groups may be designated by number, as 1, 2, nitrochlorobenzene. (b) The system of numbering is usually followed in naming polysubstitution products of benzene, the compound being referred back to benzene or to another substance derived from benzene whose characteristic group is present. In this latter class the unnamed group is always regarded as assuming the 1 position; i.e. 2, 5, nitrobenzoic acid is represented,—



**Benzenoid.** Having the structure of benzene, particularly the Kekulé constitution, as distinguished from the "quinoid" form.

**Benzene.** A product of petroleum boiling between 120° and 150° and composed of aliphatic hydrocarbons. Not to be confounded with benzene which is a chemical individual and an aromatic hydrocarbon.

**Benzenyl.** The group  $\text{C}_6\text{H}_5\text{C} \begin{smallmatrix} \nearrow \text{R}_2 \\ \searrow \text{R} \end{smallmatrix}$

**Benzo-.** A prefix denoting presence of the group  $\text{C}_6\text{H}_5\text{C} \begin{smallmatrix} \nearrow \text{R} \\ \searrow \text{R} \end{smallmatrix}$

**Benzoyl.** The radical  $C_6H_5CO-$ .

**Benzyl.** The radical  $C_6H_5CH_2-$ .

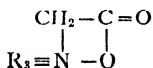
**Benzylidene.** The benzal radical.

**Berthollet's Rule.** If, on mixing two substances in solution, a reaction can take place one of the products of which is insoluble or volatile under the given conditions, the reaction will take place.

**Beryllium.** See Glucinum.

**Bessemer Process.** A method of making steel invented by Bessemer in 1855, and modified by Snelus in 1872 and by Thomas and Gilchrist in 1878. Pig iron is melted in a pear-shaped vessel known as the converter through the bottom of which air is forced into the molten metal. This treatment burns out a desired amount of carbon. The modifications consist in lining the converter with burned dolomite which combines with the sulphur and phosphorus present in the iron.

**Betaines.** Inner anhydrides of amino acid derivatives containing a hydroxyl attached to the nitrogen atom which splits water with the carboxyl group, thus joining the nitrogen to the carboxyl carbon atom. They have the general constitution,—



**Biacid.** A base able to neutralize two molecules of a monobasic acid or one of a dibasic acid; calcium hydroxide,  $Ca(OH)_2$ , is a *biacid* base.

**Bibasic.** Dibasic, see "acid."

**Bicarbonate.** An acid carbonate, viz.,  $KHCO_3$ .

**Bicarburetted.** A compound which contains two atoms of carbon in the molecule. (Obs.)

**Bichloride.** A compound which contains two atoms of chlorine in the molecule.

**Bichromate.** A salt of dichromic acid  $H_2Cr_2O_7$ . A dichromate.

**Biennial.** (bot.) A plant of two years' duration.

**Bihydroguret.** A compound of two atoms of hydrogen with another element. (Obs.)

**Bilocular.** (bot.) Two celled.

**Biniodide.** A salt of hydriodic acid which contains two atoms of iodine.

**Binoxalate.** An acid oxalate.

**Binoxide.** A dioxide.

**Biochemical Resolution of Inactive Compounds.** The method of resolving optically inactive compounds, racemes, into active substances by employing bacteria, yeasts, and fungi to destroy one of the enantiomorphic forms present. Thus, Pasteur found that the penicillium glaucum assimilates and so destroys the dextro-ammonium tartrate. Other bacteria, etc., show different tastes, some attack dextro forms, others the laevo forms. None of these organisms attack both of the isomers, however, and a laevo-assimilating one would starve in the presence of unlimited dextro material. The phenomenon is known as selective assimilation.

**Biochemistry.** That branch of chemistry which deals with the processes of living organisms and the products derived from them.

**Biolytic.** An agent which can destroy life.

**Bioses.** Monosaccharoses which contain but two atoms of carbon. Glycollic aldehyde is the only known member of the class.

**Birefringence.** Double refraction of light. It is expressed as the difference between the highest and lowest indices of refraction.

**Birotaion.** Freshly prepared solutions of glucose show an optical rotation of 105.2 while, after standing for some time, the rotation sinks to one-half the above value or 52.6. The phenomenon was termed birotation but this has been discarded for the more comprehensive term "mutarotation" (q.v.).

**Biscuit Ware.** The product of the first firing of porcelain. It is unglazed and porous.

**Bisexual.** (bot.) Having both stamens and pistils.

**Bismuth.** Element. Bi. At. Wt. 208.0, S. G. 9.7474, Spec. Heat 0.03013, M. P. 269°, B. P. 1435°. Principal valence three but compounds are known in which the element has a valence of five. Oxides,  $\text{Bi}_2\text{O}_3$ ,  $\text{Bi}_2\text{O}_5$ . Its normal salts react with water to form basic compounds of which the basic carbonate and basic nitrates are pharmaceutically important.

**Bismuthyl.** A name applied to the radical  $\text{BiO}$  which occurs in certain basic salts of bismuth.

**Bisulphate.** An acid sulphate, as  $\text{KHSO}_4$ .

**Bisulphide.** A compound which contains two atoms of sulphur.

**Bisulphite.** An acid sulphite, as  $\text{KHSO}_3$ .

**Bisulphuret.** A bisulphide. (Obs.)

**Bitartrate.** An acid tartrate, as  $\text{KO.OC.CHOH.CHOH.COOH}$ .

**Bitter Principles.** A generic term applied to proximate principles of plants characterized by bitterness of taste and usually by medicinal value.

The class includes the glucosides and alkaloids.

**Bivalent.** (Divalent.) Able to combine with and saturate two univalent radicals or their equivalent. (V. valence.)

**Blast Furnace.** An apparatus for the reduction of iron ore. It consists of a tall cylindrical chamber with a charging device at the top through which quantities of coal or coke, lime, and iron oxide are admitted; near the bottom is a ring of tubes, called twyers, through which hot air is blown into the furnace; below is the hearth with lateral openings for drawing off the slag and the molten iron separately. The ore is brought to a white heat near the top of the furnace and as it descends is reduced to molten metal when much of the phosphorus, sulphur, and silicon originally in the ore combines with the lime to form the slag. Blast furnaces are now fitted with checkerwork chambers of brick which are heated by the waste gases from the furnace and serve to preheat the air for the twyers. The product of the blast furnace is known as pig iron.

**Bleaching.** The process of whitening fibres or fabrics either by destroying the coloring matter or by converting it into a colorless substance. Two methods are in use. 1. Oxidation,—by far the more important and more generally employed,—consists in burning the coloring matter with moist chlorine or other oxidizer. 2. Reduction, converting the color into a colorless compound as by the use of moist sulphur dioxide.

**Bloom.** A bluish fluorescence characteristic of petroleum distillates which contain paraffin.

**Blowpipe.** A curved tube of metal or earthenware through which air may be blown and used to deflect the flame of a lamp or gas burner in such a way

that an object may be heated either in the reducing or oxidizing flame. Oxyhydrogen B. An apparatus for burning hydrogen and oxygen together at one jet. The combustion furnishes an intensely hot flame, so that platinum and the most refractory metals may be melted by it.

**Blown Oils.** Fatty oils which have been oxidized by a stream of air blown through them. This treatment increases their specific gravities and viscosities. Cotton-seed and rape oils are those most commonly "blown" but other fatty oils as arachis, olive, lard, and linseed are sometimes so treated.

**Boiling Point.** The temperature at which, under a given condition of pressure, a pure liquid and its vapor can co-exist. In practise boiling points are referred to the standard atmospheric pressure (760 mm.) and those determined at other pressures are qualified by an exponent which indicates the pressure, as  $80^{\circ} 14^{\text{mm}}$ . (see below and Critical point). The effect of pressure on the boiling point is to raise it proportionately to the increase in pressure or to lower it in proportion to the decrease in pressure. Thus the boiling point of water is lowered  $0.37^{\circ}$  by a decrease in pressure of 1 cm. of the mercury barometer.

**Boiling Point, of Solutions.** The solution of a non-volatile substance in a liquid always lowers the vapor tension of the system and so raises the boiling point of the solvent. In dilute solutions the effect is proportional to the molecular ratio between the solvent and solute but in concentrated solutions deviations from this rule occur. (See Law of Raoult.)

**Boiling Point, Regularities of.** See law of Kopp.

**Boiling Point, Absolute.** The boiling point on the absolute scale, numeri-

cally equal to the boiling point in degrees Centigrade plus  $273.1$ .

**Bolometer.** (Actinic or Thermic Balance.) An instrument used to measure the heat radiated by different parts of the spectrum.

**Bond.** A symbol used to denote the number and attachments of the valencies of an atom in constitutional formulas. The bond is represented by a dot (.) or line (—) drawn between the atoms, as  $\text{H.O.H}$  or  $\text{H—O—H}$ . *Double* and *Triple* bonds are used also and may express unsaturation, particularly when they join two atoms of the same element. Examples,  $\text{C}:\text{O}$ ,  $\text{H}_2\text{C}:\text{CH}_2$ ,  $\text{Ca}:\text{O}$ ;  $\text{N}:\text{CH}$ ,  $\text{HC}:\text{CH}$ .

**Boron.** Element. B. At. Wt. 10.9. Exists in two allotropic modifications; 1. Amorphous, S. G. 2.45, Spec. Heat 0.3066, 2. Crystalline, S. G. 2.63, Spec. Heat 0.165. Valence 3, Oxide  $\text{B}_2\text{O}_3$ . Occurs naturally as boric acid and as borates of which the sodium salt, borax, is the most important.

**Bound Oxygen.** In autoxidation, that part of the oxygen which unites with the substance undergoing oxidation.

**Brass.** An alloy of copper and zinc in variable proportions but usually containing 30% of zinc. Other metals may be occasionally added.

**Britannia Metal.** An alloy of 90% tin and 10% antimony. Occasionally 2 or 3% of zinc or 1% of copper is added.

**British Thermal Unit.** (B.T.U.) The quantity of heat required to raise one pound of water through one degree Fahrenheit. It is equal to 3.96 large calories.

**Bromide.** A compound derived from hydrobromic acid by substitution

of an element or radical for the hydrogen

**Brominate.** (Bromate.) To add bromine to a substance either directly or through replacement.

**Bromine.** Element. Br. At. Wt. 79.92, Mol. Wt. 159.84 ( $\text{Br}_2$ ), S. G. 3.1883, Sp. Heat 1.017, M. P.  $-7.3^\circ$ . B. P.  $58.7^\circ$ . Valence 1. Occurs as sodium bromide. Bromine is a reddish liquid.

**Bromine Absorption Number.** Fatty oils add bromine directly and the amount of the halogen so absorbed is used as an analytical test for the purity of the oil. This bromine number may be converted into the "iodine number" by multiplying it by 1.5875.

**Bromine Substitution Number.** Rosin and rosin oil form bromine derivatives by a substitution reaction in which a molecule of hydrobromic acid is formed for every atom of bromine which combines with the rosin or rosin oil. By determining the amount of bromine used up the amount of the rosin or rosin oil may be calculated.

**Bromism.** A condition which arises in certain cases after the prolonged ingestion of bromides into the organism. It is characterized by the appearance of pustules all over the body.

**Bromuret.** A bromide.

**Bronze.** An alloy of copper and tin in variable proportions. As usually found it also contains zinc, a common mixture consisting of copper 88%, tin 10%, and zinc 2%. Phosphor

bronze contains 90 parts of copper, 9 parts of tin and 0.5 to 0.8 parts of phosphorus. Silicon bronze is of a similar composition but the phosphorus is replaced by silicon. Manganese bronze contains 70% of copper and 30% of manganese. Aluminium bronze is an alloy of copper containing 5 to 12% of aluminium.

**Brownian Movement.** A phenomenon described by R. Brown in 1827. When particles less than 0.01 mm. in diameter are suspended in a medium which offers no impediment to their free motion they may be observed (under the microscope) to move about in irregular paths. The motion appears to be capable of indefinite prolongation and the behavior of the particles is exactly what the kinetic theory indicates would be the behavior of molecules of the same size.

**Bunsen Coefficient.** (Absorption coefficient.) The volume of gas under standard conditions of temperature and pressure (S.T.P.) which is absorbed by unit volume of gas solution.

**Burn.** To oxidize so rapidly that the products of the oxidation are rendered incandescent.

**Butyl-.** The univalent radical  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-}$ .

**Buzylene.** An unisolated nitrogen hydride,  $\text{NH:N.NH.NH}_2$ , known in its derivatives.

**By-Product.** A secondary product of a reaction or of manufacture obtained in addition to the primary product.

## C.

**C.** The conventional abbreviation for Centigrade. Written also Cent. See "symbols."

**c.c.** (Sometimes written c.cm.) Abbreviation for cubic centimeter.

**Cgm.** (Ctgm.) Abbreviation of centigram.

**Cm.** Abbreviation of centimeter.

**Cacodyl.** A methyl arsenic compound,  $(\text{CH}_3)_2\text{As}-\text{As}(\text{CH}_3)_2$ , diarsen-tetramethyl. It forms a series of salts, e.g. the chloride,  $(\text{CH}_3)_2\text{AsCl}$ , and an acid,  $(\text{CH}_3)_2\text{AsO.OH}$ , whose sodium salt is medicinally important.

**Cadmic.** A salt containing cadmium, in which the metal is divalent.

**Cadmium.** Metallic Element. Cd. At. Wt. 112.4, Valence 2 (cadmous salts, in which the metal apparently is univalent, have been prepared. Cf. Am. Chem. Jour., 12. 493). S. G. 8.642, Spec. Heat, 0.0584, M. P.  $321.7^\circ$ , B. P.  $778^\circ$ . Found in many zinc ores. Oxide CdO. The gas molecule of cadmium is monatomic.

**Caesium.** Metallic Element. Cs. At. Wt. 132.81, Valence, 1, S. G. 1.87, Spec. Heat, 0.04817, M. P.  $26.37^\circ$ , B. P.  $670^\circ$ .

**Calcareous.** Said of minerals or other materials which contain calcium carbonate or,—by extension of meaning,—lime.

**Calcic.** A salt which contains calcium.

**Calcination.** } Heating at a high tem-  
**Calcine.** } perature in order to  
render a mass friable or to drive off a

volatile or oxidizable substance, as the calcination of limestone to produce lime.

**Calcium.** Metallic Element. Ca. At. Wt. 40.07, S. G. 1.4153, Spec. Heat, 0.1453, M. P.  $780^\circ-810^\circ$ , Valence 2, Forms but one series of compounds, Oxide (lime) CaO. Very abundant and widely distributed over the earth's surface.

**Caloric.** Heat. (Obs.)

**Calorie.** A unit for the measurement of the quantity of heat. Unless qualified, the unit is always the amount of heat required to raise one gram of water from  $15^\circ$  to  $16^\circ$  C. on the air thermometer scale. This unit is known as the *small* calorie (cal. kal.). The *large* calorie (Cal. Kal.) is 1,000 times the small one; i.e. the amount of heat required to raise one kilogram of water from  $15^\circ$  to  $16^\circ$  C. on the air thermometer scale. The variability of the specific heat of water at different temperatures causes a variation in the value of the calorie determined at other temperatures than  $16^\circ$ . The *zero* calorie is the amount of heat necessary to raise one gram of water from  $0^\circ$  to  $1^\circ$  C.; the *mean* calorie is variously given as  $1/100$ th of the amount of heat required to raise one gram of water from  $0^\circ$  to  $100^\circ$  C. or as the total quantity of heat required under those circumstances.

### Relationships.

1 calorie	equals	0.00396 B.T.U.
"	"	42,600 gram centimeters (Mech. equiv.).
"	"	41,830,000 ergs.
"	"	4.183 joules.

24.25 calories equal 1 litre-  
atmosphere.

1.005 " " 1 zero calorie.

The small calorie is also termed the *gram-calorie* (g-cal.) and the *standard calorie*.

**Calorimeter.** An apparatus for measuring the heat change in a system whether produced by mechanical energy or chemical reaction. In its usual form it consists of a metallic vessel surrounded by water which is warmed by the heat evolved from the reaction or combustion taking place in the metallic vessel. From the temperature change of the water and its weight and after application of necessary corrections the heat units evolved may be calculated. Berthollet's bomb, modified by several men, is a common type of calorimeter.

**Calorimetry.** The art of measuring heat change quantitatively.

**Calorizator.** An apparatus used in the diffusion process for extracting beets consisting of steam jacketed brass pipes through which the juice flows from one digester to another. It is arranged to maintain a temperature of 60° C. in the extracting liquid. Called also "juice warmer."

**Calx.** The residue from the calcination of mineral matter. In the older terminology oxides were named metallic calxes. In pharmacy calx is quicklime.

**Camphan Group.** A class of terpenes characterized by the linking of two carbon atoms, in the para position, one of which carries the methyl group, by the  $\text{CH}_2\text{C} \begin{smallmatrix} \diagup \\ \diagdown \end{smallmatrix} \text{CH}_3$  group.

Camphene is a member and camphor a derivative of this group.

**Camphors.** An ill-defined classification of vegetable principles usually associated with, or derived from, the

volatile oils. They are solids, strongly odorous, very volatile, many of them are derivatives of terpenes. Cf. camphor; menthol—mint camphor; thymol—thyme camphor.

**Capacity, Heat.** } The heat ca-

**Capacity, Thermal.** } pacity of a substance is that quantity of heat, expressed in calories, necessary to raise one gram of the substance from 15° to 16° C. It differs from specific heat in being an absolute, not a relative, property. Specific heat is the ratio between the heat capacity of any substance and the heat capacity of water.

**Capillarity.** A phenomenon which depends upon the forces of cohesion and adhesion manifested by the rise within a small tube of a liquid in which the tube is immersed or a depression of the liquid in case it will not wet the tube. Other examples are the absorption of liquids by bibulous papers, the rise of oil in a lamp wick and the swelling of wood in water. The force of adhesion is so minute as to be insensible and, therefore, capillary phenomena are usually explained through surface tension (q.v.).

**Capillary Pressure.** The pressure developed through capillary action, e.g. when a wedge driven into a crevice in a rock is wetted the swelling of the wood is frequently great enough to split the rock.

**Capsule.** An evaporating dish. (Obs.)

**Carbazotic Acid.** Picric acid.

**Carbides, Metallic.** Compounds of carbon and the metals. They may be divided into two classes, those which are decomposed by water and those which are stable towards that liquid. Calcium carbide and silicon carbide (carborundum) are technically of great importance.

**Carbinol.** I. Methyl alcohol. II. A term proposed by Kolbe for the root-compound whose radical is found in all members of an homologous series and to which the members may be referred for naming; thus, benzene may be considered the carbinol of its homologues and we refer back to it in aromatic nomenclature for such compounds as methylbenzene, ethylbenzene, dimethylbenzene, etc. The term carbinol, however, is usually restricted now to the saturated, aliphatic alcohols and their derivatives though the idea is universally used.

**Carbohydrates.** A large and important group of compounds which contain carbon, hydrogen, and oxygen, the last two elements,—in most cases,—in the proportions to form water. They form the largest proportion of the solid constituents of all plants. The crystalline, sweet members are usually called sugars; the amorphous, tasteless compounds are called starches and cellulose. The carbohydrates are classified according to their chemical natures as *Monosaccharoses* (monosaccharides, glucoses), *Disaccharoses* (disaccharides, saccharoses), and *Poly-saccharoses* (polysaccharides, amyloses). The monosaccharoses are further subdivided into *Aldoses* and *Ketoses*, and into sub-classes according to the content of carbon atoms as *bioses*, *trioses*, and so up to *nonoses*. Thus a six carbon sugar which contains an aldehyde group is both an aldose and a hexose; the two terms are accordingly contracted into *aldo-hexose*. Cf. keto-hexose. Certain authors add a fourth class to the above, viz., the *trisaccharides*, of which raffinose,  $C_{18}H_{32}O_{16}$ , is the only member. It should probably be embraced in the disaccharoses as an etherial derivative of the monosaccharoses.

**Carbohydrogen. } Carbohydrate.**  
**Carbohydride. }**

**Carbolic.** I. C. Acid, Phenol. II. C. Oil, a fraction obtained in the distillation of coal-tar boiling between either  $170^{\circ}$ – $225^{\circ}$  or  $210^{\circ}$ – $240^{\circ}$  depending upon the process used.

**Carbon.** Element, C. At. Wt. 12.005, exists in three allotropic forms. I. Diamond, S. G. 3.5, II. Graphitic, S. G. 2.1 to 2.5, III. Amorphous, S. G. 1.75 to 2.10. Sublimable, M. P.  $3500^{\circ}$ . Valence, principle 4, subordinate 2 and 3. Oxides,  $CO$ ,  $CO_2$ ,  $C_3O_2$ .

**Carbon Compounds, Inertia of.** A characteristic of the compounds of carbon is the low velocity of reactions in which they are factors. This slowness is assumed to be due to inertia peculiar to carbon. Thus, while sulphurous acid is quite unstable, the methyl derivative,  $CH_3SO_2OH$ , (methylsulphonic acid) is much more stable; the stable esters of the unstable orthocarbonic acid afford another example. Nernst considers that many polymeric forms of hydrocarbons could not exist were it not for the inertia of carbon compounds for they would tend to go at once to the system of greatest stability corresponding to their elementary composition.

**Carbon Compounds, Unsymmetrical.** Organic substances which contain one or more asymmetric carbon atoms. (Vide Isomerism, optical.)

**Carbon, Neutrality of.** The element carbon is neither strongly positive nor negative in chemical behavior and the character of the other elements in carbon compounds as well as their relative positions usually determines the positive or negative properties of the compound or radical.

**Carbon Compounds, Nomenclature of.** The International Conference on Chemical Nomenclature held in Geneva in 1892 adopted a set of rules for the naming of organic substances which has been generally accepted by



chemists and used in describing new compounds since that time. The older names for long-known substances like acetic and formic acids, glycerin, and benzoic acid are commonly retained for use instead of the Geneva names methanic acid, etc. The rules adopted at the conference follow:

The suffix "ane" is adopted for all the saturated hydrocarbons of the fatty series. The present names for the first four members of the series, methane, ethane, propane, and butane, are retained; the names of the higher homologues are to be derived from the Greek numerals for the number of carbon atoms, i.e. pentane, hexane, etc. These names designate the normal hydrocarbons. Hydrocarbons with forked chains are regarded as derivatives of the normal hydrocarbons and are named from the longest normal chain which can be established in their formulas. The position of the side chain is determined by counting the carbon atoms from the nearest terminal carbon atom to that one which bears the side chain. In case there are two side chains placed symmetrically, the simpler decides the choice. When the side chain itself is substituted by an alkyl residue the terms metho, etho, etc. in place of methyl, ethyl, etc. are to be employed (and its position is determined by numbering the carbon atoms of the side chain beginning with that one nearest the normal chain. N.B. The terms isopropyl, isobutyl, tertiary amyl, etc. which are common in organic chemistry are usually employed in designating those compounds which fall under this rule, but as the more complex derivatives are prepared they shall have to be named in accordance with it).

In naming the unsaturated hydrocarbons the following principles are to be followed: Compounds which contain a single double bond are given the suffix "ene," as ethene, propene; if

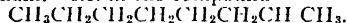
there are two double bonds the suffix is "diene," as propadiene; if there are three, then "triene" etc. The position of the double bond is indicated by the number of the first carbon atom to which the double bond is attached. (In modern practise this is indicated by a greek delta followed by the number written as an exponent, i.e.  $\Delta^1$ .)

The suffix "ine" is allotted to the triple bond hydrocarbons with the extensions "diene," "triene," etc. as ethine, hexadiene.

Compounds which contain both double and triple bonds are terminated by the suffix "enine," "dienine," etc.

The saturated hydrocarbons with closed chains are named from the saturated fatty hydrocarbons by prefixing "cyclo" to the name of the fatty compound. Hexamethylene is termed cyclohexane in accordance with this rule.

The carbon atoms of a lateral chain bear the same number as the carbon atom to which the chain is attached with an index which denotes their rank in the side chain counting from the point of union with the normal chain. I.e. in the compound



the carbon atom marked with a star would be numbered 2<sup>1</sup>.

In case two side chains are attached to the same carbon atom the same system of numbering is employed but the numbers which indicate atoms of the simpler chain are to be accentuated.

The same principles are to be employed in the nomenclature of the cyclic compounds with side chains.

The unsaturated hydrocarbons are numbered like the corresponding saturated compounds. In cases of ambiguity or in the absence of a side chain the number 1 is allotted to the carbon atom nearest the double bond.

This numbering of the hydrocarbons

is to be retained for all of their substitution products.

The alcohols and phenols are named from the hydrocarbons from which they are derived by adding the suffix "ol" to that of the parent hydrocarbon. (This rule has been discarded in naming the phenols.) For polyatomic alcohols the suffixes "diol," "triol," etc. are to be used, as propanetriol for glycerol.

The term mercaptan is discarded and the suffix "thiol" adopted to designate this function. (This rule is not generally followed.)

The fatty acids derive their names from their parent hydrocarbons (always considering the carboxyl carbon a part of the normal chain) by the addition of the suffix "ic." Polybasic acids are similarly named using the suffixes "dioic," "trioic," "tetraic," etc.

Monovalent acid residues are denominated by transforming the "ic" termination of the acids to "oyl."

In numbering the monovalent acids with normal or symmetric chain, the carbon atom of the carboxyl group bears the number 1.

Acids which contain one or more atoms of sulphur in place of as many atoms of oxygen are named according to the valence relation between sulphur and the carbon; if they are joined by one bond the term to be used is "thiol" inserted between the name of the hydrocarbon and the acid termination "ic." If the bond is double the insert is "thion." Thus:

$\text{CH}_3\text{COSH}$  is named ethanethiolic acid.

$\text{CH}_3\text{CSOH}$  ethanethionioic acid.

$\text{CH}_3\text{CSSH}$  ethanethionthiolic acid.

The ethers are to be designated by the names of the hydrocarbons which compose them joined by the term "oxy," as, pentane-oxy-ethane.

Acid anhydrides are named after their acids.

The usual conventions for naming salts and compound ethers (esters) are adopted.

Lactones are designated by the suffix "olid." The position of the hydroxyl group is the parent alcohol-acid is indicated by using the greek letters  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , beside the conventional numbering of side chains.

Lactonic acids derived from bibasic acids are named like the lactones from which they are derived by adding the suffix "ic."

In the aromatic series and all compounds which contain a closed chain, all lateral chains are considered substituents.

Aldehydes are designated by the suffix "al."

Sulphurated aldehydes: suffix "thi-al."

Ketones are named by substituting "one" for the final "e" of the name for the parent hydrocarbon. "Dione," "trione," etc. are used for diketones etc. The modern tendency is to drop the final "e" in the ketone suffix making it simply "on." Thio-ketones are designated by the suffix "thione."

The suffix "quinone" was retained for the homologues of benzoquinone. "Diquinone" and "triquinone" are used for compounds which contain more than one quinone structure.

No change in the nomenclature of the amines, phosphines, stibines, arsines, sulfines, amides, amidoximes, amidines, carbylamines, sulphones, was reported.

Such compounds which contain the bivalent group  $-\text{NH}-$  closing a chain formed of positive radicals are called imines.

Oximes are named according to the above rules. Isonitroso compounds are named as oximes.

$\text{CH}(\text{OH}).\text{CH}_2\text{CH}_2\text{CH}_3$ .

1 Butanoxime.

$\text{CH}_3\text{CH}_2\text{C}(\text{NOH}).\text{CH}_3$  2 Butanoxime.

Urea was retained as a generic term for the alkyl derivatives of urea; the acid derivatives of urea are termed ureids.

The generic term guanidine is retained but derived compounds are

named as substitution derivatives of diamidocarbonyl-imidine.

The suffix "taine" was adopted for the betaines.

Aromatic nitriles are designated by the prefix "cyano." The aliphatic nitriles were not decided upon. It is, however, the present practise to name the nitriles after the acids which they form upon hydrolysis, i.e. acetonitrile.

Sulphides are to be named by inserting the term "thio" between the names of the two saturated components. Disulphides are to be designated by the insert "dithio." This rule is not in general use now.

Isocyanic ethers are to be designated by the suffix "carbonimide."

The term cyanates is restricted to those compounds which yield cyanic acid or its direct hydration products upon saponification.

The name sulphocyanate is replaced by thiocyanate.

The use of the terms azo and diazo was changed thus:

$C_6H_5N_2Cl$ . Diazobenzene chloride.

$C_6H_5N_2C_6H_5$ . Benzene-azo-benzene.

$C_6H_5N_2C_6H_4N_2C_6H_5$ . Benzene-azo-benzene-azo-benzene.

This system is not followed today. (See Diazo and azo compounds.)

**Carbonate.** A salt of the hypothetical acid  $H_2CO_3$ . All carbonates dissolve in dilute acids with evolution of carbon dioxide. The carbonates of the alkaline metals are soluble in water. All others are insoluble but the carbonates of the alkaline earth metals and certain others to a slight extent dissolve in aqueous solutions of carbon dioxide.

**Carbonation.** In beet sugar refining, the process of precipitating, with a stream of carbon dioxide, the lime which has been added to the juice to neutralize the free acids and precipitate the albuminoids.

**Carbonic.** An adjective used to express a content of quadrivalent carbon.

**Carbonide.** A carbide (obs.).

**Carbonium Valence.** An assumption by Baeyer to indicate the difference between colored and colorless salts of certain hydrocarbons. The valence is indicated by a wavy line, as in triphenylmethylsulphate,



**Carbonize.** I. To convert into carbon. II. To cause the assumption of carbon, as in the cementation process for making steel. III. To cleanse wool of vegetable matter by soaking it in a bath of aluminium chloride (or dilute sulphuric acid) ridding it of excess moisture, and placing it in heated chambers where the aluminium chloride is decomposed: the hydrochloric acid thus formed attacks the foreign matter and renders it so friable that it is easily removed in a beating machine.

**Carbonometer.** Any instrument for measuring the content of carbon. Usually applied to an instrument designed to approximate the amount of carbon dioxide in a gas by precipitation of calcium carbonate from lime water.

**Carbonyl.** I. The group  $:C:O$ . II. A compound formed by the union of carbon monoxide with a metal. Nickel carbonyl  $Ni(CO)_4$ , a colorless, volatile liquid, and Iron carbonyl  $Fe(CO)_4$  are known.

**Carboxide.** A metallic carbonyl derivative. (See above.)

**Carboxyl.** The group  $-C-OH$   
 $\parallel$   
 $O$

characteristic of organic acids. Unless otherwise qualified, the addition of the suffix "acid" to a carbon com-

pound indicates the presence of the carboxyl group. Exceptions are carbolic acid and picric acid.

**Carboy.** A large glass bottle or flask enclosed in a box or wickerwork for protection. Used for shipments of acids, ammonia, and other liquids.

**Carburet.** A carbide (obs.).

**Carburetted.** Combined with carbon, as "carburetted hydrogen" an obsolete name for acetylene.

**Carburettor.** An apparatus employed in the manufacture of illuminating gas from water gas in order to supply the illuminants which water gas lacks. It consists of a chamber rigged with a checker-work which is heated hot by waste gases. When it is at the proper temperature, the waste gas is shut off and water gas allowed to pass through while a stream of oil is admitted through the top of the chamber. The oil furnishes hydrocarbons such as acetylene, ethane, ethylene and benzene to the gas. The process is known as carburetting.

**Carbyl.** A generic term applied by Löwig to radicals which consisted, according to his notion, of two or more atoms of carbon only. Thus,  $C_2$  "oxatyl" was considered the radical of oxalic acid. (obs.)

**Caseharden.** To convert the surface of a wrought iron article into steel.

**Catabolism.** See metabolism.

**Catalase.** (Peroxidase.) An enzyme which accelerates the decomposition of hydrogen peroxide and certain biological peroxides liberating free oxygen. It occurs in many animal and plant tissues and various kinds of catalases are distinguished as animal catalases or vegetable catalases according to their source.

**Catalysis.** A changing of the velocity of a chemical reaction by the presence of a substance which does not appear in the final products of the reaction. Berzelius (1836) applied this term to those reactions which do not progress unless a catalyst is present in the mixture. "Contact actions" (Mitscherlich) and "cyclic actions" (Brodie) have been suggested as names for the phenomenon. In general, the following rules hold true for all catalytic processes: The catalyst has the same composition at the beginning as at the end of the reaction. A small quantity of the catalyst is capable of effecting the transformation of an indefinitely large quantity of the reacting substance. No catalytic agent has power to start a chemical reaction; it may merely modify the velocity of that reaction. The catalyst has no effect upon the final state of equilibrium of opposing reactions. The velocity of two inverse reactions is affected in the same degree by a catalyst. The state of equilibrium is independent of the nature and quantity of the catalyst. Catalysis is universal. Catalytic phenomena are classified according to two systems:

*Ostwald's classification* (Zeit. Elektrochem. 7, 995. (1901)).

- I. Crystallization from supersaturated solutions.
- II. Catalyses in homogeneous systems.
- III. Catalyses in heterogeneous systems.
- IV. Action of the enzymes.

*Henri and Larguier des Bancel's Classification*, (Compt. Rend. Soc. Biol. 55, 864. (1903)).

- I. Reactions induced by one catalytic agent.
  - (i) Simple contact action.
  - (ii) Formation of intermediate compounds.
- II. Reactions which take place in the presence of two catalysts.
  - (i) The two catalysts produce the same final products.
    - (1) Simple contact action.

- (a) Catalysts have no action on one another.
  - (b) Catalysts mutually influence each other's action.
  - (2) Formation of intermediate compounds.
  - (ii) The two catalysts produce different reactions.
  - (iii) Two consecutive reactions are produced by the two catalysts.
- (Cf. Mellor, "Chemical Statics and Dynamics.")

Instances of catalysis may be found in the hydrolysis of esters by dilute acids, in the "contact process" for the manufacture of sulphuric acid, the action of enzymes, although these catalysts do not appear capable of inducing the transformation of indefinitely large quantities of material, in the retardation of the oxidation of sulphites by free oxygen in the presence of alcohol, and by the effect upon the solubility of "insoluble" chromic chloride by traces of chromous chloride in the solvent.

Catalysis may be positive, as when the reaction velocity is accelerated; or negative, as when the catalyst retards the reaction.

**Catalysis, Heterogeneous.** The phenomenon where catalysis proceeds in a heterogeneous system, as the catalysis of gaseous mixtures by solid catalysts.

**Catalysis, Homogeneous.** That case of catalysis where the factors of the reaction and the catalyst are all included in one phase.

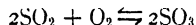
**Catalysis, Pseudo- (Catalysis by Transvection.)** A term used to distinguish those cases where it is known that the catalyst takes part in the reaction. "Cyclic action" is proposed as a name for this.

**Catalyst. (Catalytic Agent. Catalyst.)** The substance which modifies the velocity of a chemical reaction without being permanently affected in a chemical sense by the reaction. Any substance may possibly exert a catalytic influence upon some reaction. The physical condition of the catalyst largely influences its activity: platinum black is far more active than platinum foil.

**Catalysts, Negative.** Substances which retard the velocity of chemical reactions by negative catalysis.

**Catalytic Force.** See Catalysis.  
**Catalytic Action.**

**Catalytic Process for Sulphuric Acid. (Contact Process.)** A method for the manufacture of sulphur trioxide and its subsequent conversion into sulphuric acid depending upon the direct oxidation of sulphur dioxide by atmospheric oxygen in the presence of a catalyst. The reversible reaction



begins at nearly 200°, reaches a maximum at 420° and ceases at 1,000°. The catalysts used are spongy platinum as platinized asbestos or non-volatile, soluble sulphate, and the ferric oxide residue from incinerated pyrites. Many substances "poison" the catalyst and must be removed from the gases before they enter the apparatus. Dust, arsenical matter, sulphur, mercury compounds, all injure the catalyst. The apparatus must be cooled to prevent the decomposition of the sulphur trioxide. The product is obtained by absorption in concentrated sulphuric acid, whereby the fuming acid is produced. This may then be diluted to any strength.

**Cataphoresis.** See kataphoresis.

**Catelectrode.** The cathode.

**Cathetometer.** (Kathetometer.) An instrument for accurately measuring differences in height. It consists of a horizontal telescope mounted upon an adjustable standard which is graduated. The telescope is set at the lower height and a reading taken; then it is elevated to the upper and a second reading taken. The difference between the readings is the distance between the heights. The instrument gives very accurate results.

**Cathode.** The negative pole of a battery or cell. (See cell.)

**Cathode Rays.** (Cathode Streams.) A stream of electrons discharged from the cathode of a vacuum tube. They are capable of causing phosphorescence, chemical changes, mechanical effects, to raise the temperature of bodies which are subjected to their bombardment, to penetrate solids, to cause mechanical effects and to give rise to x-rays. (See electron.)

**Cations.** Positively charged ions. Those which carry the positive current in a cell and are deposited on the cathode. They travel in the nominal direction of the current. Cations include all the metals and hydrogen. In electrochemical reactions they are designated by a dot or a plus sign placed above and behind the atomic symbol, as  $\text{H}^\cdot$  or  $\text{H}^+$ , the number of dots or plus signs indicating the quantivalence of the ion. (See Cell, Ion, Anion.)

**Cationic Current.** That portion of the total current which is carried by the cations.

**Caustic.** A term applied to the water soluble hydroxides of the metals to distinguish them from their carbonates.

**Cel.** (From "celeritas.") A unit of velocity defined as the velocity given to one gram by a force of one dyne

acting for one second, or one centimeter per second.

**Cels.** Celsius. Used occasionally instead of the abbreviation "C" for centigrade.

**Cell.** (Element.) An apparatus for the transformation of chemical into electrical energy. The essential parts of the cell are, the containing vessel, the electrodes, and the electrolyte solution. The electrodes are usually plates of metal or carbon immersed in the electrolyte solution, the electrode by which the current leaves the cell is termed the cathode, that through which the current enters is called the anode. The mechanism of the generation of electrical energy is this; the electrolyte is ionized, the anions migrate towards the anode while the cations travel to the cathode. At the anode the anions are discharged and, either combine with the metal or are deposited upon it, the cations are simultaneously discharged at the cathode and deposit upon it. The charges of the ions are thus communicated to the electrodes and appear in the outside circuit. The heat ordinarily evolved by the reaction does not appear in the cell inasmuch as, the chemical energy having been converted into electrical energy the heat change is quite small.

**Cell, Cadmium.** A standard or "normal" cell usually constructed in the "H" form. The cathode is an amalgam of  $12\frac{1}{2}$  parts of cadmium and  $87\frac{1}{2}$  parts of mercury by weight. The anode may be made of highly purified mercury or of amalgamated platinum. The electrolyte is a saturated solution of cadmium sulphate in water. The cathode is surrounded by undissolved cadmium sulphate crystals and the anode is covered with a paste made of mercurous sulphate and cadmium sulphate solution. The cell is sealed to prevent evaporation. At the

ordinary temperature (20°) the cadmium cell furnishes an electromotive force of 1.0186 volts and this varies but 0.00007 volt per degree change of temperature.

**Cell, Clark's.** A standard cell designed by Latimer Clark in 1872. The anode is a zinc rod and is immersed in a saturated solution of crystallized zinc sulphate; the cathode is mercury and is covered with a paste of mercurous sulphate. The cell must be kept below 39° C. at which point the zinc sulphate heptahydrate suffers a transition into the hexahydrate causing a change in the electromotive force of the cell. At ordinary temperatures (20°) the Clarke cell furnishes 1.4267 volts but it is seriously affected by small changes in temperature.

**Cell, Concentration.** A cell in which similar electrodes are placed in different concentrations of the same electrolyte, or in which the electrodes are formed of amalgams which contain different proportions of the same metal in a solution of an electrolyte which contains the metal. The formula for calculating the E.M.F. of such a cell is,

$$\pi = \frac{0.000198}{2} T \log \frac{c}{c_1} \text{ volts,}$$

where  $c$  and  $c_1$  represent the concentration in the more concentrated and more dilute phases respectively.

**Cell, Diffusion.** An apparatus used for extracting beets in the sugar industry. It consists essentially of a percolator charged with the sliced beets into which warm juice from a previous cell is fed.

**Cell, Gravity.** An electrolytic cell in which the exciting fluid and the depolarizer are separated by difference in specific gravity instead of by a porous cup. The gravity battery is an illustration. It consists of a copper cathode placed in the bottom of

the battery jar and covered with a saturated solution of copper sulphate. Upon this floats dilute sulphuric acid in which the zinc anode is immersed.

**Cell, Oxidation and Reduction.** A cell in which the electric energy is produced by the interaction of a reducing and an oxidizing substance in separate solutions each bathing an electrode.

**Cell, Transition.** A cell which contains an electrolyte capable of undergoing a transition at some definite temperature. The Clark cell furnishes an instance of this. (See Cell, Clarke's.) At 39 the two hydrates are in equilibrium but to convert the hepta-hydrate into the hexa-hydrate requires heat so that at the transition point the E.M.F. of the cell will be 0. while it will increase in opposite senses as the temperature rises or falls from that point.

**Celsius.** Centigrade.

**Cementation.** The process of surrounding a solid body with a powder of some substance with which it is desired to combine it and heating the whole to some temperature below fusion. The solid combines with the powder and the resulting compound gradually diffuses through the object being cemented. Thus wrought iron is converted into steel by heating with powdered charcoal.

**Centigrade.** (Celsius.) Abbreviated C or Cels. A thermometric scale based on the fusion point of water for 0° and the boiling point of water under standard pressure for 100°.

**Centimeter.** The hundredth part of a meter. 1 centimeter equals 0.3937 inches. Abbreviated cm.

**Centimeter Cube.** Any solid figure whose length, breadth, and thickness are each one centimeter. The volume

of such a solid is one cubic centimeter. The distinction is made because a cubic centimeter is not restricted to any definite shape and, in certain measurements, especially electrochemical, the dimensions of the cubic centimeter become highly important.

**Ceric.** A salt of cerium in which the metal is quadrivalent.

**Cerium.** Element. Ce. At. Wt. 140.25, S. G. 7.042, Spec. heat, 0.04479, M. P. 623° C. Valence 3 and 4. Forms ceric and cerous compounds.

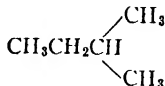
**Cerous.** A salt of cerium in which the metal is trivalent.

**C.G.S.** The abbreviation for the centimeter-gram-second system of physical units. The corresponding English units are the foot, pound, and second.

**Chain.** A series of atoms connected by bonds forming the skeleton of a number of derivatives. The carbon chains are the most important.

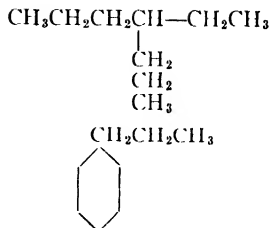
**Chain, Closed.** When the terminal atoms of a chain mutually combine the series forms a ring and the chain is said to be "closed." Such closed chains, or rings, are of great importance in organic theory.

**Chain, Forked.** A chain which divides at some point producing two new chains attached to the parent chain. Isopentane,—



contains a forked chain.

**Chain, Lateral or Side.** A chain of atoms combined with a longer chain, which may be either open or ring-shaped.



In either case the propyl group is the lateral or side chain.

**Chain, Open.** A series of atoms linked in a chain the terminal atoms of which are not mutually combined. Such chains are characteristic of the aliphatic compounds.

**Chamber Acid.** The direct product of the lead chambers in the manufacture of sulphuric acid. It is a dilute acid which contains 62 to 70% of sulphuric acid.

**Char.** 1. To carbonize. 2. To burn slightly. 3. Charcoal, especially animal charcoal which is also called "animal or bone char."

**Charge, Atomic.** The notion that each ion carries a definite quantity of electricity which is proportional, not to the atomic weight, but to the valence of the element under the conditions. The charge on a single, univalent ion is one electron or  $1.1 \times 10^{-19}$  coulombs.

**Charges, Fictitious.** Electric charges which appear to reside in the dielectric in an electrical condenser as distinguished from the "true" charges of the plates.

**Chemical Theory of Dyeing.** (See dyeing.)

**Chemical Theory of Tanning.** (See tanning.)

**Chemick. Chemism.** Affinity.



**Chemiluminescence.** The direct transformation of chemical energy into visible radiant energy. This explains the luminosity of phosphorous, of the fire-fly, and the phosphorescence sometimes observed on decaying wood or herring brine.

**Chemistry.** Chemistry is that branch of natural science which investigates the composition of all matter and the transformations it exhibits upon subjection to energy change.

**Chemistry, Applied.** (Industrial.) The application of chemical laws and processes to the arts.

**Chemistry, Biological.** (Physiological.) A division of chemistry which investigates the chemical mechanism of the living organism and the chemical processes of metabolism.

**Chemistry, Forensic.** The application of chemical knowledge to the solution of legal problems.

**Chemistry, Inorganic.** The branch of chemistry which treats of all elements and compounds with the exception of all but the simplest compounds of carbon. The distinction is no longer significant but is retained on account of its convenience. (See Chemistry, organic.)

**Chemistry, Organic.** The branch of chemistry which deals exclusively with the compounds of carbon. The distinction between inorganic and organic chemistry was made at the time when it was the general belief among chemists that the processes of the organism and their products differed in an essential degree from processes not associated with life and their products. This idea has long since been discarded but the distinction has been retained because the enormous number of the carbon compounds and certain peculiarities which arise from the ability of carbon to

combine with itself and furnish long chains which are characteristic of carbon compounds make it convenient to consider the chemistry of carbon by itself.

**Chemistry, Pharmaceutical.** A branch of applied chemistry which deals with the composition and preparation of medicinal materials.

**Chemistry, Photo-.** That division of chemistry which investigates the phenomena associated with the mutual transformations of radiant energy and chemical energy. Photography and other chemical phenomena produced by light fall under this head.

**Chemistry, Physical.** A broad division of chemistry which is investigating the border land between physics and chemistry. It treats of the relations between energy and chemical change as well as of any chemical changes which occur with a change of state of aggregation.

**Chemistry, Physiological.** (See chemistry, biological.)

**Chemistry, Structural.** A term applied to investigations of the constitution of the molecule.

**Chemistry, Thermo-.** A branch of chemistry which treats of the relations between heat-change and chemical change. Called also, chemical thermodynamics.

**Chemolysis.** The decomposition of organic substances by chemical reagents outside the organism. (Obs.)

**Chemosmosis.** The phenomenon of chemical action taking place through an intervening membrane.

**Chemotaxis.** (Chemotropism.) A phenomenon shown by living cells and microorganisms which move towards or away from some point at which the chemical composition, concentration,

or equilibrium is different from that of their initial location. If the cells are attracted by the chemical stimulus the phenomenon is known as positive chemotaxis; if they are repelled it is termed negative chemotaxis. The phenomenon is believed to be the cause of the accumulation of leucocytes at points of infection.

**Chemotropism.** See chemotaxis.

**Chloride.** A salt of hydrochloric acid or a substance in which chlorine has been substituted for hydrogen.

**Chlorimetry.** The process of determining the "available chlorine" in bleaching powder. The term may be extended to include any analysis to determine chlorine.

**Chlorinate.** To combine with chlorine. Specifically, the process of adding chlorine to or substituting chlorine for hydrogen in a compound.

**Chlorination.** The process of chlorinating.

**Chlorination, Exhaustive.** The prolongation of chlorination until all the replaceable hydrogen (or other element) has been substituted by chlorine. Thus hexachlorbenzene  $C_6Cl_6$  is formed by the exhaustive chlorination of many benzene derivatives.

**Chlorine.** Element. Cl. At. Wt. 35.46. Gaseous at ordinary temperatures. Mol. Wt. 70.92, M. P.  $-102.0$ . B. P.  $-33.60$ . Principal valence, 1. Oxides,  $Cl_2O$  and  $ClO_2(Cl_2O_4)$ . Acids, hydrochloric  $HCl$ ; hypochlorous,  $HClO$ ; chlorous,  $HClO_2$  (unknown in free state); chloric,  $HClO_3$ ; and perchloric,  $HClO_4$ .

**Chlorite.** A salt of chlorous acid.

**Chlor-** } A prefix used to indicate  
**Chloro-** } content of non-ionizable chlorine, as chlorobenzene.

**Chlorometer.** An instrument for determining the bleaching power of "chloride of lime."

**Chlorometry.** Chlorimetry.

**Chloroplast.** The protoplasmic body within the cell which is stained green by chlorophyll.

**Chloruret.** A chloride. (obs.)

**Chromate.** A salt of the hypothetical chromic acid  $H_2CrO_4$ .

**Chromic.** A salt of the metal chromium in which the metal is trivalent.

**Chromite.** A combination of chromic oxide with another metallic oxide, especially with ferrous oxide.

**Chromium.** Element. Cr. At. Wt. 52.0, S. G. 6.92, Spec. heat 0.10394, M. P.  $1515^\circ$ . Forms three series of compounds, chromous, chromic, and chromates. Valence, 2, 3, and 6. Oxides,  $CrO$ ,  $CrO_2$ ,  $Cr_2O_3$ , and  $CrO_3$ . Chromium may be substituted for aluminium in all the alums.

**Chromogens.** According to a theory proposed by O. N. Witt the parent substances of dyestuffs. They are formed by the substitution of a chromophore group (q.v.) in an hydrocarbon and further substitution of an auxochromic group converts the chromogens into true dyestuffs. (See chromophore, auxochrome.)

**Chromoisomerism** Isomerism in which the isomers exhibit different colors.

**Chromophore.** The atomic structures or grouping which confers the quality of color upon organic compounds without which all organic compounds are colorless. Among chromophore groups may be mentioned,—the nitro, azo, and  $C=CH$ — $CO$  groups; the quinoid is an example

of chromophore structure. Such groups do not confer dyeing properties upon the compounds which contain them; dyes are formed when the substance is further substituted by a salt-forming or auxochrome group.

**Chromoproteids.** A class of protein substances characterized by being colored. The prosthetic group (q.v.) is a colored compound in such cases. Hemoglobin and hemocyanin are the best known examples of this class of proteids.

**Chromotropism.** A process of isomeric change in which a change of color is involved.

**Chromous.** Salts of chromium in which the metal is divalent.

**Cinnamenyl.** The radical  
 $C_6H_5.CH : CH.CH :$

**Cinnamyl.** The radical  
 $C_6H_5.CH : CH.CH_2..$

**Cis.** A prefix used to distinguish alloisomers and applied to the one to which is assigned the plane symmetric configuration (or the malenoid form.) Baeyer has suggested the use of the Greek letter  $\Gamma$  to precede the name of all geometric isomers; therefore it may be placed before the *cis*, as  $\Gamma$  *cis*. Formerly the prefix was doubled, the malenoid form being denoted by *cis*, *cis* while the fumaroid form was distinguished as *cis* *trans*. This nomenclature has been superseded by the more simple terms *cis* and *trans*. (See, *Trans*, *Isomerism* *Cis-Trans*, *Configuration* *Axially Symmetric* and *Plane Symmetric*.)

**Cis-Trans Isomerism.** See *Isomerism*, *cis-trans*.

**Clapeyron Equation.** (Clausius-Clapeyron equation.) An equation which permits the calculation of the change in the boiling point of a liquid

due to change in pressure. Where  $\lambda$  represents the heat of vaporization of one gram of the liquid,  $p$ , pressure,  $T$ , absolute temperature,  $v_1$ , specific volume of the liquid, and  $v_2$ , specific volume of the vapor,

$$\frac{dp}{dT} = \frac{\lambda}{T(v_2 - v_1)}.$$

**Clayed Sugars.** Raw sugars which have been freed from molasses by gradual washing with water through a layer of clay with which the sugar is covered.

**Cleavage.** A property of crystals by virtue of which they split more readily in certain directions than in others leaving nearly smooth faces. It is due to the fact that there is a minimum of cohesion between the molecules in the direction of cleavage.

**Co-Electron.** An hypothetical nucleus to which electrons are assumed to be attached the whole forming the atom.

**Co-Ferment.** Any substance which increases or makes possible the action of an enzyme. Thus phosphates and a complex organic phosphate have been shown to increase the activity of the yeast ferment and blood does not clot in the absence of calcium salts, apparently because calcium salts are necessary for the conversion of the blood zymogen into thrombase, the clotting ferment.

**Coagulation.** 1. The process of complete or partial solidification of a sol to a gelatinous mass; or of the separation from a liquid system of a gelatinous mass. It involves the separation of the disperse from the continuous phase which fact distinguishes it from "gelation." 2. The result of an alteration of a disperse phase or of a dissolved solid which causes the separation of the system into a liquid phase and an insoluble

mass, as the coagulation of egg albumin.  
 3. The separation of a gelatinous mass from a liquid system, as the clotting of blood. Derived terms: coagulate; coagulator; coagulum.

**Coal Tar.** A heavy, strongly odorous, black oil produced in the distillation of coal out of contact with the air. It collects in the "tar well" where it gradually separates from the ammoniacal "gas liquor" which floats on its surface. The tar is then drawn off through a cock in the bottom of the tar well. The composition of coal tar varies somewhat according to the temperature and kind of coal employed in producing it but is, in general, as follows; a small number of aliphatic hydrocarbons, aromatic hydrocarbons of the benzene, naphthalene, anthracene, phenanthrene, and chrysene series, heterocyclic compounds containing nitrogen and sulphur, phenols, amines, and ketones. (Cf. Watt's Dictionary of Chemistry for a complete list.)

**Cobalt.** Element. Co. At. Wt. 58.97, S. G. 8.718, Spec. heat 0.103, M. P. 1464°, Valence, 2 and 3. Oxides CoO, Co<sub>2</sub>O<sub>3</sub>, and Co<sub>3</sub>O<sub>4</sub>. The cobaltous compounds are the more stable; when hydrated they are pink in color and become green when rendered anhydrous.

**Cobalt-Ammonium Compounds.** Cobaltous salts form five series of complex derivatives with ammonia a list of which follows, the chlorides being taken for illustration:

Tetrammoniocobaltic chloride,  
 $\text{Co}_2\text{Cl}_6(\text{NH}_3)_4$ .  
 Hexammoniocobaltic chloride,  
 $\text{Co}_2\text{Cl}_6(\text{NH}_3)_6$ .  
 Octammoniocobaltic (praseocobaltic) chloride,  
 $\text{Co}_2\text{Cl}_6(\text{NH}_3)_8$ .  
 Decammoniocobaltic (roseo- and purpureo-cobaltic) chloride,  
 $\text{Co}_2\text{Cl}_6(\text{NH}_3)_{10}$ .

Dodecammoniocobaltic (lutecobaltic) chloride,  
 $\text{Co}_2\text{Cl}_6(\text{NH}_3)_{12}$ .

**Cobaltic.** Salts of cobalt in which the metal is trivalent.

**Cobaltous.** Salts of cobalt in which the metal is divalent.

**Coefficient of Activity.** A term used by Arrhenius in the early development of the dissociation theory when he considered that there were two kinds of molecules, those which conducted the current and were "active" and inactive molecules. At infinite dilution all the molecules were assumed to be active. The coefficient of activity expressed the ratio between the active molecules and the sum of the active and inactive molecules.

**Coefficient, Affinity.** The degree of dissociation calculated from the observed depression of the freezing-point.

**Coefficient, Critical.** An additive property of substances which is also a measure of the space actually occupied by the molecules and is proportional to the critical volume. It is expressed as the ratio between the critical temperature  $\theta_0$  and the critical pressure  $\pi_0$ , or

$$k = \frac{\theta_0}{\pi_0}.$$

**Coefficient, Distribution.** The ratio between the concentrations of a solute in two immiscible solvents which are in contact. (See Law, Distribution.) Called also, partition coefficient.

**Coefficient, Evasion.** A factor ( $\beta$ ) which expresses the number of milliliters of a gas under standard conditions evolved per minute from one square centimeter of the surface of its solution in a liquid.

**Coefficient, Invasion.** A factor ( $\gamma$ ) used to denote the number of milli-

liters of a gas under standard conditions absorbed by one square centimeter of surface in one minute.

**Coefficient, Partition.** See Coefficient, distribution.

**Coefficient of Purity.** (Quotient of Purity.) An inexact factor used in the sugar industry obtained by multiplying the polarization of the juice by 100 and dividing the product by the reading it gives with the Brix hydrometer. It furnishes an approximation of the quantity of pure sucrose present.

**Coefficient, Velocity.** (Velocity constant. Specific speed of reaction.) The rate of transformation of unit mass of a substance in a chemical reaction. The factor is found by dividing the observed rate of change by the concentration of the reacting substances.

**Coexistence of Reactions, Principle of.** When a number of reactions are simultaneously taking place in any system, each obeys the law of mass action, and each proceeds as if it were independent of the others; the total change is the sum of all the independent changes.

**Coferrmentation.** A condition of fermentation in which the principal enzyme is unable to carry on its specific reaction in the absence of a coferrment. (See Coferrment.)

**Cohesion.** Molecular attraction between the particles of any given mass by virtue of which the mass tends to resist physical disintegration. It differs from adhesion which refers to surface attractions.

**Cohobation.** A process of distilling in which the distillate is repeatedly returned to the still.

**Colature.** A liquid which has been strained.

**Collimator.** The objective tube of a spectroscope. It is equipped with a convex lens and a slit and serves to parallelize the rays emitted by the volatilized element under observation and to direct the rays into the prism. The tube which contains the eye-piece is known as the telescope.

**Colloidal.** Existing in the colloid state. (See Colloids.)

**Colloids.** Non-crystalloids. Substances which form two-phase systems with solvents which exhibit the gross properties of solutions or, modifications of crystalline substances which are capable of forming such systems. The former view that the colloid is essentially different from substances which form true solutions is giving way to the consideration that the colloidal state is merely a condition into which all, or nearly all, substances can be brought by suitable means. Colloidal "solutions" do not obey the solution laws: the alterations of the boiling and freezing points are inappreciable and the osmotic pressures very small. A colloidal solution is, in reality a disperse system and such measures which separate disperse systems will usually cause the coagulation and precipitation of colloids. Ostwald (Outlines) distinguishes between two classes of colloidal liquids, one in which the suspended colloid does not sensibly affect the properties of the dispersive medium, such as suspensions of metals, metallic sulphides, or clay; and the class where the reverse is true as in the case of gelatine solutions which "set" to jellies below a certain temperature.

**Colloids, Reversible and Irreversible.** A distinction based, I. on the fact that certain substances immediately assume the colloidal state on contact with pure water. These are termed reversible colloids. Others remain insoluble when once separated from the disperse

system. There is no real theoretical distinction between the classes for the phenomenon depends upon the velocity with which the disperse particles form grains of precipitable size, and all such "reversible" colloids eventually become irreversible. II. Colloids which like agar or gelatine form both solutions and two phase systems with water according to temperature are termed reversible.

**Colorimeter.** An instrument for measuring the intensity of a colored liquid by comparing it with a liquid of standard color. Such instruments are of service in the quantitative estimation of substances which cannot readily be isolated and do not furnish quantitative precipitates with reagents but which do develop colors during certain reactions.

**Columbium.** Element. Cb. At. Wt. 93.1, called also Niobium. S. G. 7.04, M. P. 1950°. Valence 5, Oxide  $\text{Cb}_2\text{O}_5$ , acid  $\text{H}_3\text{CbO}_4$ .

**Combination.** A term indicating the operation of a chemical process by which two or more individual substances or two or more molecules of a single substance condense to form a new chemical individual.

**Combination Tanning.** A process of tanning hides which depends upon the use of two tanning agents, as gambier and alum, instead of a single one.

**Combining Weight.** A property of elementary substances which determines their proportions by weight in compounds. Numerically it is equal to the atomic weight of the element divided by the valence which it exhibits in the compound. Also known as equivalent weight.

**Combining Weights, Laws of.** See Laws of combining weights.

**Combustion.** The combination of an oxidizable substance with an oxi-

dizer, usually oxygen, frequently with the production of heat and light.

**Combustion, Fractional.** A method of separating and determining gaseous mixtures by burning one constituent (usually hydrogen) under conditions such that other combustible components are unaffected.

**Combustion, Heat of.** The amount of heat, in kilojoules, evolved or absorbed during the combustion of one gram-molecule of any substance at constant pressure. It indicates the difference between the amounts of chemical energy before and after the combustion plus a certain amount of mechanical work arising from the difference in volume of the factors and products of the reaction. This last quantity may be excluded by conducting the combustion under conditions of constant volume. The heat of formation of a compound may be calculated by subtracting this from the sum of the heats of combustion of its component elements. The heat of combustion is very nearly an additive property; it depends, however, slightly upon molecular constitution so that isomers do not give identical heats of combustion.

**Co-Molecule.** A group of atoms held together by pairs of electrons shared by adjacent atoms. (Langmuir.)

**Compensation, External.** A term used to denote a racemic condition of optical isomers. (See Isomerism, optical.)

**Compensation, Internal.** The condition where the optical activity of a substance which contains an even number of asymmetric carbon atoms is not exhibited, through opposing activities of the asymmetric atoms which neutralize each other. Such a case presents an "inactive indivisible type." (See Isomerism, optical.)

**Compensator.** A device used in saccharimeters for measuring the rotation of the sugar solution instead of employing the usual rotating analyzer. It consists of two wedges of dextro-rotatory and a block of laevorotatory quartz. The wedges are so fixed that one may be shifted to change the thickness of the quartz layer through which the light must pass. The zero point is read when the combined thickness of the two dextro wedges equals that of the laevo block. On inserting a tube of sugar solution into the instrument the quartz wedge must be shifted to bring less dextro quartz into the line of vision until the whole is just neutral again. The amount of displacement measures the rotatory power of the sugar solution.

**Components, Active.** Enantiomorphs.

**Components, Independent.** Those variable factors of a reaction which determine the order of reaction and are not themselves fixed. (See Phase rule.)

**Compound.** A pure substance which consists of two or more chemical elements in union.

**Compound, Active.** A compound which exhibits optical activity, i.e. rotates the plane of polarized light.

**Compounds, Binary.** Berzelius (1831) used this term to distinguish compounds which could be divided into two parts, one electro-positive and the other electro-negative, from all others particularly organic compounds. The term has fallen into disuse.

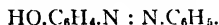
**Compounds, Heterocyclic.** Substances which contain a ring-shaped nucleus composed of dissimilar elements. A few inorganic substances fall into this classification but by far the majority of them are carbon compounds. In organic chemistry sub-

stances of cyclic structure, as acid anhydrides, lactides, lactams, lactones, cyclic ethers, and cyclic derivatives of dicarboxylic acids which are formed by the elimination of water from aliphatic compounds and are readily converted back into aliphatic compounds are not considered among the heterocyclic substances. Derivatives of pyridine, quinoline, thiophene, thiazole, pyrone, etc., which contain heterocyclic rings that persist in the compound through chemical reactions are considered the true members of this class. Heterocyclic rings are known which contain nitrogen, sulphur, and oxygen members. The non-carbon members of the ring are termed "hetero-atoms" and their number is indicated by the prefixes mono, di, tri, tetra, etc. The number of members in the ring may reach as high as sixteen, as in tetrasalicylide.

**Compounds, Homologous.** Members of an homologous series (q.v.).

**Compounds, Hydrocyclic.** Substances formed by the complete reduction of carbocyclic compounds, Ex. hexamethylene  $C_6H_{12}$  formed by the reduction of benzene,  $C_6H_6$ .

**Compounds, Hydroxyazo.** Azo derivatives which contain an hydroxyl group, as hydroxyazobenzene,



**Compounds, Inactive.** Substances which do not affect the plane of polarized light. They may contain asymmetric carbon atoms which are rendered inactive by internal or external compensation.

**Compounds, Iodonium.** Compounds of iodine in which that element is trivalent.

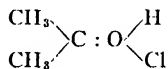
**Compounds, Isocyclic.** Substances which contain a ring-shaped nucleus composed of the same element through-

out, as benzene, naphthalene, and their derivatives. Cf. heterocyclic compounds.

**Compounds, Molecular.** Compounds formed by the union of two or more already saturated molecules apparently in defiance of the laws of valence. The class includes double salts, salts with water of crystallization, and metalammonium derivatives. They are considered the result of molecular attraction rather than atomic. They do not differ in any characteristic manner from compounds formed in strict accordance with the doctrine of valence. Cf. Werner and Miolati, *Zeit. phys. Chem.* 12. 35. (1893).

**Compounds, Organic.** See Carbon compounds, and Chemistry, organic.

**Compounds, Oxonium.** Molecular compounds of oxygen-containing organic substances with inorganic acids and certain salts. Alcohols, acids, aldehydes, esters, ethers, and ketones add directly to hydrochloric, hydrobromic, hydriodic, nitric, acids, stannous chloride, and chlorplatinic acid. All the possible compounds which may result from the union of a member of one of these groups with all the members of the other group have been observed. The union is assumed to take place through the oxygen atom which changes in valence from two to four, i.e.



Such compounds give definite and constant heats of formation and constant melting points. The above list does not attempt to exhaust the classes of compounds nor the acids which can form salts of this type.

**Compounds, Partially Racemic.** Optically active compounds may crystal-

lize together in double salts though of different structure. When the two compounds are of opposite rotatory power the double salt is said to be a partially racemized compound. Thus Pasteur obtained a double salt of ammonium d-tartrate and acid ammonium l-malate.

**Compounds, Racemic.** See Isomerism, optical.

**Compounds, Saturated.** Compounds in which the valence of all the atoms is completely satisfied without linking any two atoms by more than one valence bond. Cf. Compounds, unsaturated.

substances to supply the deficiency. In organic chemistry such compounds are distinguished by a double or triple bond connecting the atoms which are unsaturated.

**Conalbumin.** A coagulable, non-crystalline, nitrogenous substance obtained during the purification of egg albumin.

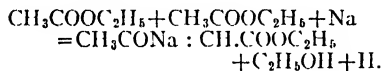
**Concentration, Critical.** When two immiscible liquids are heated in contact with each other their mutual solubility is usually increased until at the critical solution point they become consolute. The composition of the two solutions immediately before they become consolute is the critical concentration.

**Condensation.** 1. Liquefaction. See condense. 2. A class of reactions between organic molecules or parts of the same molecule in which water, hydrochloric acid, ammonia, alcohol, or similar substance is eliminated and a new bond between carbon atoms is formed, or such union without elimina-



tion as in the aldol condensation. The process is usually not reversible. Esterification, alkylation, acylation, and the formation of compounds in which the union takes place through an oxygen or nitrogen atom are not regarded as condensations. See specific examples below.

**Condensation, Acetoacetic Ester.** A class of reactions occasioned by the dehydrating power of metallic sodium or sodium ethoxide on the ethyl esters of monobasic aliphatic acids and a few other esters. It is best known in the formation of acetoacetic ester:



The actual course of the reaction is still a subject of controversy. By the action of acids the sodium may be eliminated from the first product of the reaction and the free ester obtained. This may exist in the tautomeric enol and keto forms. On boiling the ester with acids or alkalis it will split in two ways, the circumstances determining the nature of the main product. Thus, if moderately strong acid or weak alkali is employed acetone is formed with very little acetic acid (ketone splitting). In the presence of strong alkalis however, very little acetone and much acetic acid result (acid splitting). Derivatives of acetoacetic ester may be decomposed in the same fashion and from this fact proceeds the great usefulness of this condensation in organic synthesis.

**Condensation, Aldol.** A reaction between aldehydes or aldehydes and ketones which occurs without the elimination of any secondary product. It is distinguished from polymerization by the facts that it occurs between aldehydes and ketones and is not generally reversible. In its simplest form it may be represented by the

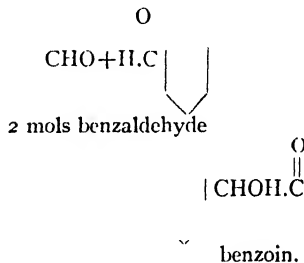
condensation of two molecules of acetaldehyde to aldol:



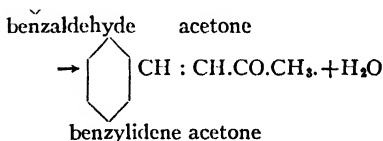
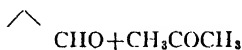
Weak alkalis and acids are employed to effect the condensation. Cf. condensations, benzoin, crotonaldehyde, Claisen's, and pinacol.

**Condensation, Aromatic.** The formation of cyclic compounds by the condensation of aliphatic substances. Cf. polymerization, aromatic.

**Condensation, Benzoin.** A condensation of two molecules of aromatic aldehydes effected by potassium cyanide. Benzaldehyde condenses with itself to form benzoin,



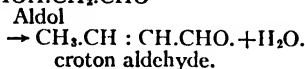
**Condensation, Claisen's.** (Claisen's reaction.) The condensation of aldehydes with aldehydes or ketones in the presence of dilute sodium hydroxide, e.g.



The use of sodium alcoholate to effect other condensations, especially those

of 1-3 diketones, is known as Claisen's method.

**Condensation, Crotonaldehyde.** A condensation of aldehydes with elimination of water. The first step is the aldol condensation from the product of which water is split out and an unsaturated aldehyde results, viz.,



**Condensation, External.** (Inter-molecular condensation.) Condensation in which two or more molecules combine, as distinguished from internal condensation. E.g. the aldol condensation.

**Condensation, Friedel-Craft's.** Condensation of compounds, especially hydrocarbons, with halogen compounds in the presence of anhydrous aluminium chloride, whereby a halogen acid is eliminated, viz.,

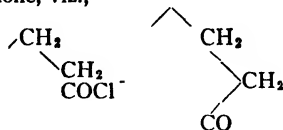


Alkyl halides yield hydrocarbons; acyl halides yield ketones; and carbonyl chloride yields ketones and acids. Anhydrous ferric chloride may take the place of the aluminium salt.

**Condensation, Hydrolytic.** The condensation of one or more molecules of aliphatic compounds with the elimination of water, especially if ring compounds are formed. Such condensations might more properly be termed hydrosynthetic condensations. An example is the condensation of three molecules of acetone to form one molecule of trimethylbenzene and three of water.

**Condensation, Internal.** (Intra-molecular condensation.) Condensation in which combination takes place between carbon atoms in the same

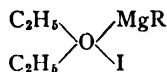
molecule, as the condensation of  $\beta$  phenylpropionyl chloride to form hydriindone, viz.,



**Condensation, Intermolecular.** See condensation, external.

**Condensation, Intramolecular.** See condensation, internal.

**Condensation, Magnesium-Alkyl.** (The Grignard or Barbier-Grignard reaction.) A condensation effected by the introduction of magnesium into an halogen compound of one of the factors dissolved in ether and then reacting on this "reagent" with the second factor whereby magnesium halides or basic halides are eliminated and condensation products formed. The "reagent" is formed according to the following reaction,  $\text{RI} + \text{Mg} + \text{Ether} \rightarrow \text{RMgI} + \text{Ether}$ , it being believed that the ether is combined thus,

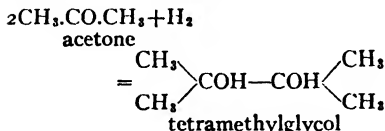


With water the reagent yields an hydrocarbon,  
 $2\text{RMgI} + 2\text{H}_2\text{O} = 2\text{R.H} + \text{Mg}(\text{OH})_2 + \text{MgI}_2.$

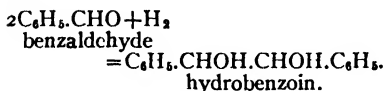
With aldehydes, ketones, and esters it yields alcohols; with cyanogen, cyanides, and amides it yields ketones; with carbon dioxide and subsequent hydrolysis it yields acids; with dialkyl-formamides ( $\text{R.R'.N}-\text{OC.H}$ ) it yields aldehydes; and numerous other types of reactions have been discovered.

**Condensation, Organo-Metallic.** See condensation, zinc-alkyl and condensation, magnesium-alkyl.

**Condensation, Pinacone.** A condensation accompanying the reduction of aldehydes and ketones especially in neutral and alkaline solutions, in which the carbonyl carbon atoms are linked together and two atoms of hydrogen are assumed, viz.,



and

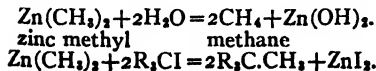


Cf. conversion, pinacone.

**Condensation, Pyro.** Condensation effected by the agency of high temperature, as methane, when conducted through red hot tubes, yields benzene. Note, the formation of benzene from acetylene under similar circumstances is not condensation, but polymerization.

**Condensation Theory of Catalysis.** Faraday suggested that the layers of a gas in the immediate neighborhood of the surface of a metal catalyst are more concentrated than the rest of the gas, i.e. more condensed, so that the molecules of the reacting substances are in closer contact and consequently the reaction takes place with greater velocity near the catalyst.

**Condensation, Zinc-Alkyl.** (Frankland's method.) Condensation in which zinc-alkyl compounds are employed to introduce hydrocarbon residues into organic substances, the zinc being eliminated as hydrate or halide, as



**Condense.** 1. To lessen the distance between the molecules of a substance or mixture. 2. To liquefy a gas. 3. To bring about a condensation reaction between compounds.

**Condenser.** (Condensor.) An apparatus for "liquefying gaseous substances, particularly those with a boiling-point above 20°.

**Condition of a Gas, Equation of.** (Characteristic equation of a gas.) The equation  $PV = RT$  where  $P$  represents pressure,  $V$ , volume,  $T$ , the absolute temperature, and  $R$ , the gas constant. The expression states that the product of the pressure into the volume is proportional to the absolute temperature times a constant. See also, Equation, van der Wall's.

**Conductance.** The power to carry a current. A property characteristic of a conductor as distinguished from conductivity which is the same property characteristic of a substance. See conductivity.

**Conductivity.** The power to carry a current. It may be defined as the current density under unit potential gradient and is the reciprocal of resistivity. The term in chemical literature usually refers to solutions and comparisons of conductivity are based upon solutions which contain one mol. Cf. Conductance.

**Conductivity, Equivalent.** ( $\lambda$ .) The conductivity of a solution which contains one gram-equivalent of solute measured when placed between electrodes which are one centimeter apart. The equivalent and molecular conductivities of solutions of compounds of univalent elements are, therefore, identical.

**Conductivity, Molecular.** ( $\mu$ .) (Molar conductivity.) The conductivity of a solution which contains one mol of solute measured when placed

between electrodes which are one centimeter apart.  $\mu = v/l$  where  $v$  equals number of cubic centimeters in which one mol is dissolved and  $l$  equals the specific conductivity of the solution.

**Conductivity, Specific.** The conductivity of a centimeter cube of a substance or a solution. It is measured in mhos (reciprocal ohms). For solutions, the specific conductivity varies with the concentration.

**Conductivity, Temperature Coefficient of.** The change in conductivity per degree centigrade rise in temperature. With solutions, the conductivity increases rapidly as the temperature rises.

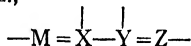
**Configuration.** The arrangement in space of the atoms of a molecule.

**Configuration, Axially Symmetric.** (Central symmetric configuration.) The spacial arrangement of the trans or fumaroid form of a stereoisomer.

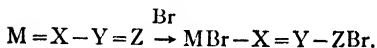
**Configuration, Plane Symmetric.** The spacial arrangement of the cis or malenoid form of a stereoisomer. See isomerism, stereo.

**Congeval.** To solidify.

**Conjugated Double Bonds.** A system of double bonds in a chain of four atoms in which the double linkings occur between atoms 1 and 2, and 3 and 4, viz.,



Thiele assumes that all four atoms show partial valence and that the partial valencies of the atoms in positions X and Y tend to unite to produce a double bond between these atoms so that addition (as of halogens) to such a system takes place in the 1-4 position. Thus



**Conjunct.** (Copula.) An idea introduced by Berzelius in support of his radical theory as applied to carbon compounds, which were supposed to consist of two parts "conjugated" together. Of these two parts, one, the conjunct, conferred distinguishing characteristics on members of an homologous series. Thus, the fatty acids were considered combinations of oxalic acid (written  $\text{C}_2\text{O}_3$ ) with the conjuncts, methyl, ethyl, propyl, etc. In chloracetic acid the conjunct was "chloride of carbon" written  $\text{C}_2\text{Cl}_6$ .

**Conoidal.** (bot.) Nearly conical.

**Conservation of Energy.** See law of.

**Conservation of Matter.** See law of.

**Consolute.** Perfectly miscible. Said of liquids when they are miscible in all proportions, i.e. mutually completely soluble, under some given conditions. Not usually applied to gases which are all miscible.

**Constant.** A magnitude which suffers no change during a specific operation. If two magnitudes are proportional, the first equals the product of the second into a "constant."

**Constant, Avogadro's.** (N.) The number of molecules in one gram-molecule. For oxygen it is stated that N lies between  $45 \times 10^{22}$  and  $200 \times 10^{22}$ .

**Constant, Critical.** Any one of the critical constants, critical pressure, temperature, volume, or density, q.v.

**Constant, Dielectric.** (c.) (Specific inductive capacity.) A measure of that property of a medium by virtue of which it modifies the mutual action of electrified bodies immersed in it or separated by it. The unit is the dielectric constant of a vacuum, and the constants for several substances are, sulphur 3, glass 3, paraffin 2, water nearly 80.

**Constant, Dissociation.** See ionization constant.

**Constant, Gas.** (R.) A general constant for gases. By combining the laws of Gay-Lussac and Boyle and rearranging we obtain the formula,

$$p_1 v_1 = p_0 v_0 \frac{T_1}{T_0} = \frac{p_0 v_0}{T_0} T_1$$

where  $p_0$ ,  $v_0$ , and  $T_0$  represent the initial conditions of pressure, volume, and temperature, and  $p_1$ ,  $v_1$ ,  $T_1$ , the final conditions. If these initial conditions are the standard conditions,  $T_0 = 273.1^\circ$  and  $p_0 = 760$  mm.,  $v_0$  must have a definite numerical value. For the term  $p_0 v_0 / T_0$  we substitute a symbol,  $R$ , which is called the gas constant.  $R$  is conditioned only by the units chosen for measurement and is independent of the chemical nature of the gas.  $R = 8.316 \times 10^7$  ergs.

**Constant, Planck's.** See quantum theory.

**Constant, Velocity.** See coefficient' velocity.

**Constitution.** 1. The arrangement of the atoms in the molecule. 2. A diagram designed to show the relative positions of atoms and groups in two dimensions. When the arrangement is projected in three dimensions, so as to show spacial relationships, it is called a configuration.

**Constitution, Unitary.** A term which expresses the idea that each compound is a unit in constitution as distinguished from the binary idea of Berzelius.

**Constitutive, Properties.** See under properties.

**Contact Process.** The catalytic process for the production of sulphuric acid. See Catalytic process.

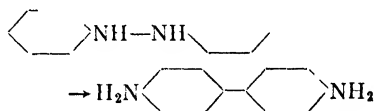
**Contravalency.** A subordinate valency. Abegg and Bodländer assume

that each atom possesses eight valencies distributed as positive and negative. The type of valence in excess is termed the normal valence and determines the positive or negative character of the atom; the subordinate valence is termed the contravalency.

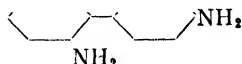
**Convection.** The transference of heat by the bodily movement of heated particles of matter, as the heating of buildings by steam or hot air.

**Conversion.** An intramolecular rearrangement of organic substances in which the relative positions of the radicals are modified. The Beckmann rearrangement is a case in point. Radicals may be transferred from carbon, oxygen, or nitrogen to carbon; from carbon or oxygen to nitrogen; from side chains to nucleus, etc. See specific examples below.

**Conversion, Benzidine.** (Benzidine rearrangement.) The intramolecular rearrangement of hydrazobenzene and its derivatives to benzidine and benzidine derivatives on boiling with mineral acids, represented



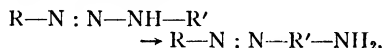
a small amount of diphenylene base



is produced simultaneously. If the para position in one of the hydrazobenzene rings is occupied the benzidine conversion can take place only if the substituent is eliminated. Cf. rearrangement, semidine.

**Conversion, Diazoamino-Aminazo.** (Diazoamino-aminazo rearrangement.) The intramolecular rearrangement of

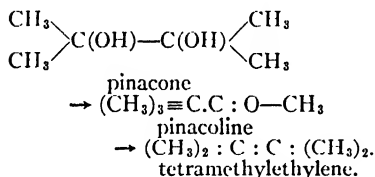
diazoamino into aminazo compounds in the presence of a small amount of the hydrochloride of an aromatic base (as p-toluidine HCl). The reaction may be represented



where R and R' are aryls.

**Conversion of Oximes.** The conversion of syn to anti and anti to syn forms of oximes by chemical treatment.

**Conversion, Pinacone—Pinacoline.** An intramolecular change in which a methyl group is transferred from carbon to carbon. The reverse change is included in the term. Viz.,



**Coppel.** A cupel, q.v.

**Copper.** (Cuprum.) Metallic element. Cu. At. Wt. 63.57. S. G. 8.9. S. heat 0.0936. M. P. 1080°. Valence 1 and 2. Forms two series of compounds, cuprous and cupric. Oxides,  $\text{Cu}_2\text{O}$ ,  $\text{CuO}$ ,  $\text{Cu}_4\text{O}$ ,  $\text{Cu}_3\text{O}$ ,  $\text{CuO}_2$ . Ores, native copper, copper oxide, malachite, azurite, copper glance.

**Copulated.** Liebig's term for "combined."

**Cordate.** (bot.) Heart-shaped and pointed upwards.

**Corolla.** (bot.) The inner perianth of a flower.

**Corpuscles.** Electrons, q.v.

**Corrosive.** Able to dissolve or destroy. Substances which corrode living tissues are termed escharotics.

Corrosion of metals is often a process of simple oxidation.

**Cotyledons.** (bot.) The first leaves of the embryo, found in the seed.

**Coulomb.** The unit quantity of electricity. It is the quantity of electrical energy which will deposit 1.1175 mgm. of silver and is, in itself, independent of time. One ampere flowing for one second will deliver one coulomb.

1 coulomb =  $10^{-1}$  c.g.s. unit of quantity.

96,540 coulombs deposit one gram-equivalent of any substance.

1 faraday = 96,540 coulombs.

**Coulometer.** (Voltmeter. Coulombmeter.) An instrument designed to measure the quantity of electric current which passes through a circuit. The common types depend upon measuring the volume of a gas evolved by the current or on weighing the amount of a metal deposited by the current.

**Countercurrent Principle.** In a continuous process, where possible, the current of material to be acted upon should run in a direction opposite to that of the processing agent so that the fresh material may first come in contact with the most worn-out agent and the fresh, most active agent may first come in contact with and exert its power upon the most exhausted material. In this way the issuing agent will be more used and the issuing material more modified, other factors being equal, than in any other. Examples may be seen in percolation, diffusion batteries, the absorption of gases in towers where the fresh gas enters at the bottom and issues from the top while the fresh absorbent enters at the top and the solution issues at the bottom, etc.

**Co-Volume, Molecular.** (Vibratory volume.) The volume occupied by

the oscillation of a gas molecule. From kinetic data it appears to be four times the material volume of the molecule. The co-volume is taken account of in the van der Wall's equation by the factor  $b$ .

**Crith.** An obsolete unit formerly used in the determination of the weights of gases. The weight of a liter of hydrogen, under standard conditions, was taken as the crith.

**Critical Phenomena.** The critical temperature, pressure, and volume.

**Critical Point.** A point where two phases, which are continually approximating each other, become identical and form but one phase. With a liquid in equilibrium with its vapor, the critical point is such a combination of temperature and pressure that the specific volumes of the liquid and its vapor are identical and there is no distinction between the two states. The critical solution point is such a combination of temperature and pressure that two otherwise partially miscible liquids become consolute.

**Critical Point, Ternary.** The point where, upon adding a mutual solvent to two partially miscible liquids (as adding alcohol to ether and water), the two resulting solutions become consolute and one phase results.

**Critical Pressure.** See pressure, critical.

**Critical Solution Point.** See critical point.

**Critical Temperature.** See temperature, critical.

**Critical Volume.** See volume, critical.

**Cruciate.** (bot.) Cross-shaped.

**Crucible.** A vessel of sand, porcelain, nickel, platinum or other re-

fractory substance used in the melting or calcination of materials or reaction mixtures at high temperatures.

**Crucible Process.** A process for making steel in which the best quality of wrought iron is melted in a clay or graphite crucible with charcoal. The molten iron then absorbs carbon from the charcoal. Oxides of manganese and of other metals may be added to produce steels for special purposes.

**Crutcher.** A mixing machine used in the manufacture of soap. The liquid soap is pumped from the boiling vats into the crutcher and stirred thoroughly while perfume, fillers, or other ingredients are added and mixed in. When the mixing has been completed the contents of the crutcher are run into the frames.

**Cryohydrates.** Eutectic mixtures of water and other components.

**Cryohydrate Point.** The eutectic point of an aqueous system.

**Cryoscopic Method.** A method for determining the molecular weight of a substance by observing the depression of the freezing point when a definite quantity of the substance is dissolved in a solvent. The formula applied is,

$$\text{M.W.} = \frac{C \cdot p}{t}$$

where M.W. represents molecular weight,  $C$ , a constant characteristic of the solvent,  $p$ , grams of substance per 100 grams of solvent, and  $t$ , the depression in degrees centigrade.

**Cryptocrystalline.** Substances whose crystalline form is "hidden" and difficult to recognize, whence they appear amorphous, e.g. flint, jasper.

**Cryptovalencies.** The third and fourth valencies of oxygen, as exhibited in the oxonium compounds.

**Crystal.** 1. A homogeneous solid body of definite geometrical form bounded by plane surfaces, formed when certain liquid or gaseous substances pass into the solid state (or crystallize). Most compounds possess a definite crystal form in the solid condition and are said to be crystalline. Substances which crystallize in two, three, or more forms are termed di-, tri-, or polymorphous. Cf. isomorphism. N.B. The adjective "crystalline" is also used to describe transparent liquids which contain no suspended matter. 2. Certain uniaxial and anisotropic liquids, see crystals, liquid.

**Crystal Alcohol.** Alcohol of crystallization.

**Crystal Carbonate.** Sodium carbonate, monohydrate,  $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ .

**Crystal Chloroform.** Chloroform of crystallization.

**Crystal Water.** Water of crystallization.

**Crystalline.** 1. Occurring in a crystal form. 2. Clear, not cloudy. See crystal.

**Crystallize.** To assume definite geometric shape. See crystal.

**Crystallization.** The process of converting liquids or gases into crystals.

**Crystallization, Fractional.** A process for the separation of a mixture in solution by arranging conditions so that one component may crystallize alone or with but small admixture of another component.

**Crystallization, Nuclei of.** Small solid particles placed in solutions upon which crystals may form. Crystals of the dissolved substance or of other substances which are isomorphous with it, grains of dust, etc., may serve as nuclei.

**Crystallization, Water of.** See water of crystallization.

**Crystalloids.** (Dispersoids.) A term used by Graham to distinguish the crystalline substances which are soluble in water and dialyze readily from amorphous compounds which dialyze not at all or only very slowly.

**Crystalloidal Solutions.** Solutions of crystalline substances or true solutions to distinguish them from colloidal solutions.

**Crystals, Aeolotropic.** Anisotropic crystals.

**Crystals, Anisotropic.** See isotropic crystals and isotropism.

**Crystals, Biaxial.** Doubly refracting crystals which have two optic axes. They show characteristic interference figures. Cf. crystals, uniaxial.

**Crystals, Isomorphous.** See isomorphism.

**Crystals, Isotropic.** See isotropic crystals and isotropism.

**Crystals, Liquid.** Crystals of very low viscosity in which the intermolecular forces which compel regular molecular arrangement are weaker than capillary or gravitational forces. They form cloudy fluids which are uniaxial, anisotropic, and melt, i.e. the cloudiness and optical properties disappear at a definite temperature at which point the arrangement of the molecules is assumed to break down. Cholesterol benzoate, and p-oxyanisole, are examples of substances which form liquid crystals. It has been contended that liquid crystals are really colloidal solutions.

**Crystals, Mixed.** Crystals which contain mixtures of two or more isomorphous compounds in the same solid. The ratio between the compounds is indefinite and the properties



of the crystals depend upon the proportions of the components. Mixed crystals are examples of solid solutions.

**Crystals, Negative.** See crystals, positive.

**Crystals, Positive.** Uniaxial crystals in which the ordinary refracted ray of light travels faster than the extraordinary ray except along the optic axis. In negative crystals the case is just reversed.

**Crystals, Uniaxial.** Doubly refracting crystals which have but one optic axis and which show characteristic interference figures, as Iceland spar, quartz, and tourmaline.

**Cubic Centimeter.** (c.c.) A unit of volume in the metric system approximately equal to a milliliter (ml.). It is defined as the volume of a cube whose edge is one centimeter, but the form of the volume need not of necessity be that of a cube. Cf. centimeter cube.

1 c.c.	0.061 cubic inches.
16.38 c.c.	1.00 " "
1.000027 c.c.	1.00 ml.

1 c.c. of pure water at 4° C. weighs 0.99996 gram.

**Cupel.** (Coppel.) (Noun.) A shallow porous vessel usually made of bone ashes used in cupellation. (Verb.) To submit to the process of cupellation.

**Cupellation.** A metallurgical process for refining noble metals especially for purposes of assay. The sample of unrefined metal mixed with lead is placed in a cupel and heated in a muffle furnace when the base metals are oxidized, part of them being volatilized at the temperature of the muffle and the rest being absorbed by the cupel leaving a "button" of noble metal. Cupellation is resorted to in the regular crucible or scorification assay for the precious metals to

get rid of the lead used to dissolve the noble metals from the ore samples.

**Cupola.** A furnace used in foundries for melting large quantities of metals, especially pig iron.

**Cupric.** A compound of copper in which the metal is divalent, as cupric chloride,  $\text{CuCl}_2$ .

**Cuprous.** A compound of copper in which the metal is univalent, as cuprous oxide,  $\text{Cu}_2\text{O}$ .

**Cuprum.** Latin name of copper.

**Current Density.** The electric current per square centimeter of conductor or of electrode immersed in a solution of an electrolyte.

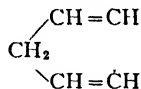
**Current Strength.** The amperage of an electric current. See ampere.

**Cyanate.** A salt of cyanic acid,  $\text{HCNO}$ , as potassium cyanate,  $\text{KCNO}$ .

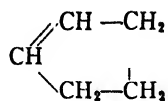
**Cyanide.** A salt of hydrocyanic acid (prussic acid),  $\text{HCN}$ , or a compound of the radical  $\text{CN}$  with another radical, as phenylcyanide,  $\text{C}_6\text{H}_5\text{CN}$ . The organic cyanides are usually termed nitriles.

**Cyclic Compounds.** Compounds which may be represented as containing a ring of atoms in the nucleus; those in which the ring is composed solely of carbon atoms are distinguished as "carbocyclic."

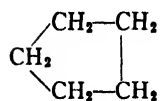
**Cyclo-Diolefins.** Unsaturated hydrocarbons with cyclic structure which contain two double bonds, as cyclopentadiene,



**Cyclo-Olefins.** Unsaturated hydrocarbons with cyclic structure which contain one double bond, as cyclopentene,



**Cyclo-Paraffins.** Saturated hydrocarbons with a cyclic or ring structure, as cyclopentane,



**Cyclo-Trioletins.** Unsaturated hydrocarbons which contain a cyclic structure and three double bonds.

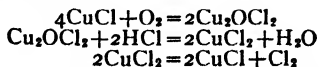
## D.

**Danysz Effect.** If diphtheria toxin be treated with its antitoxin the reduction in the toxicity of the mixture depends upon the rate at which the antitoxin is added. An amount of antitoxin which will neutralize the toxin, if added all at once, is insufficient to neutralize it if added little by little after short intervals. The longer the periods between the additions the greater the insufficiency. This is analogous to the precipitation of colloids by electrolytes where much more is precipitated if the salt is added quickly, e.g. the ratio of the amounts which produce complete precipitation is a function of the time over which the addition is extended.

**Dasymeter.** An instrument used to determine the density of a gas. It consists of a thin glass globe which is weighed in the (unknown) gas or mixture of gases and then in a gas of known density.

**Davyum.** A supposed rare metallic element from platinum ores. Symbol, Da, At. Wt. 154. Probably not a new element.

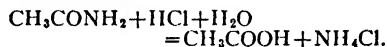
**Deacon's Process.** A method for the manufacture of chlorine in which hydrochloric acid gas mixed with air is passed over pumice stone saturated with cuprous chloride at a temperature between 350 and 577° C. 400° is the usual working heat. The reactions which take place are supposed to be the following,



The cuprous chloride reacts catalytically.

**Dead Space of Chemical Reactions.** When the surface tension of a system increases as chemical action proceeds capillarity will tend to stop the action. If any part of the system is then subjected to capillary action, as in a capillary tube, no reaction takes place. Liebreich calls this the "dead space" of the reaction.

**Deamidization.** (Desamidization, disamidization.) Any process for removing the amide group from an amide, e.g.



**Deamination.** (Desamination.) Any process by which an amine group is removed from a compound, e.g. diazotization and subsequent boiling with alcohol.

**Deacidification.** Removing or neutralizing an acid in a system.

**Deca.** (Deka.) A prefix indicating the numeral ten, as in decahydrate.

**Decarbonize.** To remove carbon from any system which contains it. The substitution of oxygen for carbon dioxide in the blood in the lungs is termed decarbonization, as is also the burning out of a portion of the carbon in cast iron to make steel.

**Decay, Period of Half.** See period of half decay.

**Deci.** A prefix derived from the Latin numeral ten (decem) and used in scientific nomenclature to indicate one-tenth of a magnitude, e.g. decigram, \_decimeter, decinormal (N 10.)

**Deciduous.** (bot.) Any plant which is not evergreen or persistent.

**Decipium.** An element announced by Delafontaine but considered to be a mixture of known rare earth elements.

**Decolorization.** The process of removing the color from any mixture.

**Decolorize.** To remove the color from, to bleach. Decolorization may be carried out in a variety of ways, 1. by adsorption, in which the coloring matter is removed from solution by animal charcoal, alumina, etc., 2. by precipitation; many coloring matters form insoluble compounds with lead, aluminium, and other heavy metals, 3. by destruction, e.g. oxidation or reduction. The agent in the process is termed a decolorizer. Cf. bleaching.

**Decolorizer.** See decolorize.

**Degradation.** 1. A gradual decomposition occurring in stages with well marked intermediate products. Ex. the maltose chain loses one carbon under certain conditions to produce a sugar with eleven carbon atoms in its skeleton. See disintegration. 2. Degradation of energy, see law of.

**Dehydrate.** To remove water from. To render anhydrous.

**Dehydration.** The process of reducing the water content of any system.

**Dehydrogenate.** To reduce the content of hydrogen in a substance. Oxidation with removal of hydrogen is dehydrogenation, but simple addition of oxygen, complete combustion, or the substitution of halogen for hydrogen is not so considered.

**Deka.** Same as deca.

**Deliquesce.**  
**Deliquescence.**  
**Deliquescent.** } Certain substances exhibit a great attraction for water

and will take it up from the atmosphere becoming themselves moist or even going into solution. Such substances are said to be deliquescent, they deliquesce, and the phenomenon is known as deliquescence.

**Deliquium.** A deliquesced mass.

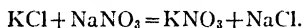
**Demi-.** A prefix from the Greek which indicates "half." Same as "semi."

**Denitration.** (To denitrate or denitrify. Denitrification.) 1. Any process for removing or altering the nitro group in an organic compound, the purpose usually being to remove the danger of explosion. The nitro group is altered by reduction being converted into the amino group which is non-explosive and the nitrogen may be wholly removed from the compound by diazotizing this reduction product and boiling with water or alcohol. 2. Bacterial decomposition of nitrites and nitrates with production of gaseous nitrogen. The bacteria which effect the change are termed *denitrifiers*. 3. Freeing the Gay-Lussac acid from oxides of nitrogen in the chamber process for sulphuric acid. See Glover tower.

**Decoction.** An aqueous solution of the water-soluble constituents of a plant made by boiling the plant in water for some time and then straining off the solution.

**Decompose.** } The division of a  
**Decomposition.** } molecule by any chemical process so as to furnish two or more new molecules. Complete decomposition refers to such a condition of the products that they are not readily decomposed further, e.g. such decomposition products as ammonia and carbon dioxide. Degradation (q.v.) refers to gradual decomposition in which the molecule is diminished by slight changes.

**Decomposition, Double.** A term used to express the result of the interaction of two salts when the base of the first combines with the acid of the second and the base of the second with the acid of the first, viz.,



This is also known as metathesis. According to the ionic hypothesis such exchanges are not realized in solution, the true condition being a formation of anions and cations and a distribution of the two bases between the two acids.

**Decomound.** (bot.) Divided or compounded more than once, as a leaf.

**Decrepitate.** } The ejection of solid  
**Decrepitation.** } particles from a mass that is being heated due to the explosions of minute amounts of liquid held within the mass.

**Decumbent.** (bot.) Reclining with an ascending summit.

**Decurved.** (bot.) Curved downward.

**Definite Proportions.** See law of.

**Deflagrate.** } The process of burn-  
**Deflagration.** } ing quickly and violently with production of flame and explosion. Cf. detonation.

**Degree.** 1. A division or interval marked on a scale, as a thermometric degree. For comparison of degrees see thermometric scales. 2. Condition in terms of some unit or in relation to some standard, as degree of acidity.

**Densimeter.** Any instrument which can be used to determine density.

**Density.** The mass per unit volume. Unit density is a mass of one gram in a volume of one milliliter. The densities of most bodies becomes less as their temperature rises. Cf. specific volume.

Density of mercury, = 13.5953 at 0°.  
osmium, = 22.48  
sulphur, = 2.00 (very nearly).

$\text{CuSO}_4 \cdot 5\text{Aq.}$  = 2.28  
Glycerin, = 1.26  
Chloroform, = 1.47  
Ether, = 0.71  
Benzol, = 0.879.

**Density, Maximum of Water.** At 4° C. water is at its maximum density, above or below that point water expands, e.g.

	gm.
at 0° 1 mil of water weighs,	0.999868
3°	0.999992
5°	0.999992
6°	0.999986
100°	0.95838
150°	0.9173
250°	0.794
300°	0.70.

**Density, Modulus of.** See law of moduli, Valson's.

**Density of Gases.** The weight of unit volume at 0° and 760 mm. pressure, at sea level and 45° latitude at 0°. Weight of 1 liter of

air,	1.2926 gm.
oxygen,	1.4290
hydrogen,	0.08987
carbon dioxide,	1.9768
(pure) nitrogen,	1.2506.

**Dentate.** (bot.) Toothed.

**Denticulate.** (bot.) Minutely toothed.

**Deoxidize.** (Disoxidize.) To remove oxygen from a molecule. To reduce. The process is termed de-oxidation.

**Dephlegmation.** A process for increasing the efficiency of fractional distillation by forcing the vapors from the still to bubble through shallow layers of condensate in a column or "dephlegmator" whereby the amount

of low boiling constituent in the vapor is increased and much of the higher boiling constituents condensed.

**Dephlegmator.** Any apparatus used in increasing the efficiency of fractional distillation, as a Hempel column.

**Dephlogisticate.** To oxidize, according to the obsolete phlogiston theory. It was supposed that a metal is a compound of its oxide and "phlogiston" and that when a metal is, as we now term it, oxidized, the phlogiston escaped.

**Dephlogisticated Air.** The old term for oxygen, applied by Priestley.

**Depolarize.** To remove the cause of the polarization of an electrode in a galvanic cell. Substances added to cells to prevent polarization are termed *depolarizers*, e.g. potassium bichromate, manganese dioxide, copper sulphate (in Daniell's cell), etc.

**Deposition, Electrical.** 1. Electroplating. 2. The depositing of elements from solutions of their compounds upon an electrode in an electrolytic cell. One faraday is required for the deposition of one gram-equivalent of any substance.

**Derivative.** (Derivant.) A term used in organic chemistry to express the relation between certain known or hypothetical substances and the compounds formed from them by simple chemical processes in which the nucleus or skeleton of the parent substance exists. Thus phenol, aniline, and toluene are derivatives of benzene and many of the terpenes are derivatives of cymene.

**Derive.** To obtain one compound from another either by actual or theoretical chemical process.

**Desiccate.** To render practically anhydrous, to dehydrate.

**Desiccator.** (Exsiccator.) A closed vessel in which desiccation may be carried out at either atmospheric or reduced pressures or in vacuo. Deliquescent substances like sulphuric acid, fused calcium chloride, or fused caustic potash are used to absorb moisture from the air in the vessel which then takes up moisture from the substance being dried. Used also to preserve material in a dry state.

**Desmotropic.**  
**Desmotropism.** } See isomerism,  
**Desmotropy.** } dynamic.

**Detonation.** A reaction which proceeds with increasing velocity and temperature until it finally reaches explosive violence with production of a report.

**Detonation Wave.** (Explosion wave.) The specific value for the rate at which combustion spreads throughout a body of gas when it is once started at any point. It is much faster than the velocity of sound in the same gas, e.g. for  $2H_2 + O_2$  it is 2810 meters per second and for  $C_2H_2 + 2O_2$ , 2195 meters per second.

**Devolution of Elements.** See elements, devolution of.

**Devitrification.** The crystallization of glass, detected by the appearance of opaque areas.

**Dew Point.** The temperature at which the actual content of water vapor in the atmosphere is sufficient to saturate the air with water-vapor. If the atmosphere contains much water vapor the dew point is higher than in the case of drier airs, so that the dew point is an indication of the humidity of the atmosphere.

**Dextro-.** (d.) A prefix used to designate dextrorotatory optical activity.

**Dextro Rotatory.** } A substance  
**Dextrorotatory.** } which has the  
property of rotating the ray of polar-  
ized light to the right or clockwise.  
See isomerism, optical.

**Diacid.** A base which can combine  
with two molecules of monobasic acid.

**Diactinic.** Having the property of  
transmitting actinic (chemically active)  
rays.

**Diactinism.** The property of trans-  
mitting chemically active rays.

**Diagonal Formula.** The Claus  
formula for benzene, see benzene.

**Dialysis.** The process of separating  
compounds by the difference in their  
rates of diffusion through a colloidal  
septum. Thus sodium chloride dif-  
fuses eleven times as fast as tannin  
and twenty-one times as fast as  
albumin. See dialyzer.

**Dialysate.** The solution of a di-  
alyzed substance.

**Dialyzer.** An apparatus for con-  
ducting dialysis usually consisting of  
two chambers separated by a septum  
of parchment paper, animal membrane,  
or other colloid. In one chamber the  
solution is placed and in the other the  
pure solvent. Crystalline substances  
diffuse from the solution through the  
septum and into the solvent much  
more rapidly than amorphous sub-  
stances or colloids.

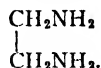
**Diamagnetic Substances.** Sub-  
stances whose permeability to the  
magnetic flux is less than that of air.  
The phenomenon is termed diamag-  
netism. Cf. Paramagnetic.

**Diamide.** 1. Hydrazine,  $H_2N-NH_2$ .  
2. An organic compound which  
contains two amido groups.

**Diamido-** A prefix indicating con-  
tent of two amido groups, as diamido-

benzene,  $C_6H_4(NH_2)_2$  (phenylenedia-  
mine).

**Diamine.** A compound which con-  
tains two amino groups, e.g. ethylenedi-  
amine,



**Diammine.** An inorganic compound  
which contains two ammine ( $NH_3$ )  
radicals.

**Danium.** An element announced  
by v. Kobell. Identical with colum-  
bium.

**Diaphoresis.** Profuse perspiration.

**Diaphoretic.** A drug which stimu-  
lates the secretion of perspiration, a  
sudorific.

**Diastase.** (Amylase.) An enzyme  
which catalyzes the hydrolysis of  
poly- to mono-saccharoses, e.g. the  
conversion of starch into dextrose.

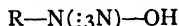
**Diatom.** 1. One of the diatomaceae,  
a family of microscopic, unicellular  
algae. 2. A living atom or particle.

**Diazo Group.** The group,  $-N_2-$   
found in the diazo compounds, e.g.  
diazobenzene chloride,



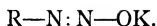
Diazo- is used as a prefix to indicate a  
content of the diazo group.

**Diazonium Compounds.** Deriva-  
tives of the diazonium hydrates,

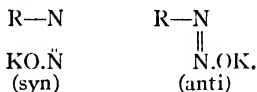


in which the hydroxyl group is re-  
placed by an acid radical.

**Diazotates.** The metallic salts of  
the diazo-hydrates, e.g.

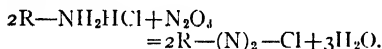


Two isomeric forms are found which Hantzsch considers due to syn-anti isomerism,



See isodiaz salts.

**Diazotize.** To introduce the diazo group into a compound, usually effected by treating an amine with any compound of nitrogen capable of releasing nitrogen trioxide. The amino group is converted into the diazo group thus,



**Dibasic.** An acid which forms salts with two atoms of univalent or with one atom of bivalent metal. According to the ionic hypothesis, a substance which liberates two hydrogen ions for each dissociated molecule.

**Dibasicity.** See dibasic.

**Dichromate.** A salt of the hypothetical dichromic acid,  $\text{H}_2\text{Cr}_2\text{O}_7$ , as  $\text{K}_2\text{Cr}_2\text{O}_7$ . Also called bichromate.

**Dichroism.** The property of exhibiting two colors, especially of exhibiting one color by reflected and another by transmitted light as in the case of solutions of chlorophyll. Substances which have this property are termed dichroic.

**Dicotyledonous.** (Dicotyledon.) A plant which has two seed leaves or cotyledons.

**Didymium.** A name given to a supposed element of the rare earths. It has been shown to be a mixture of praseodymium and neodymium.

**Dielectric.** A medium through which attraction or repulsion of elec-

tric charges may act. Such media are insulators and have a very high resistivity.

**Dielectric Strength.** The maximum difference of potential per centimeter thickness which an insulator can support without rupture.

**Dielectric Constant.** See constant, dielectric.

**Diffusate.** (Dialysate.) The solution of the diffused substance in a dialyzer.

**Diffusion.** 1. Dialysis. 2. A phenomenon depending upon the kinetic nature of the molecule by virtue of which any gas will diffuse through and occupy the total space in which it is confined and any solute will diffuse through its solvent until all portions of the solvent are approximately of the same concentration. (Cf. atmolysis, law of Graham.)

**Diffusive Substances.** Substances which readily dialyze through colloidal septa, viz., crystalloids.

**Diketones.** Organic compounds which contain two carbonyl groups.

**Dilute.** Not concentrated. A solution in which the solvent is in great excess. A relative term of no definite meaning unless qualified by a statement of the actual concentration.

**Dilute Solutions, Theory of.** Van't Hoff's theory that compounds in dilute solutions obey the same laws that apply to gases.

**Dilution.** 1. The act of increasing the proportion of solvent to solute in any solution, e.g. by the addition of the same or another (miscible) solvent. 2. Improperly used in the same sense as concentration.

**Dilution, Heat of.** The quantity of heat in calories evolved or absorbed



when a solution and its solvent are mixed or when a liquid compound is diluted with a solvent. The quantity is usually calculated on a gram or gram-molecular (molar heat of dilution) basis for the solute and infinite dilution as the limiting condition. Cf. solution, heat of.

**Dilution Law.** See law, dilution.

**Dimorphic.** See polymorphic.

**Diortho Acids.** 1. Inorganic acids formed from two molecules of ortho acid by loss of one molecule of water.



Ortho-	Diortho-
silicic	silicic
acid	acid.

2. Organic acids, derivatives of a cyclic nucleus, in which both positions ortho to the carboxyl are occupied by substituents. Such acids show the phenomenon of steric hindrance.

**Dioxide. } An oxide in which the**  
**Dioxide. } relative proportions of**  
 oxygen and other element are as two to one, e.g.  $\text{MnO}_2$ .

**Dioecious.** (bot.) Unisexual. A species in which the two types of flowers are found on different plants.

**Dioximes.** Compounds which contain two oxime (isonitroso) groups, as benzildioxime,  $(\text{C}_6\text{H}_5)_2\text{C}_2(\text{N.OH})_2$ . These compounds may exist in three isomeric forms distinguished as syn, anti, and amphi. See isomerism, syn-anti.

**Dipeptides.** Products of the combination of two amino acids, as glycylglycine, and glycylalanine.

**Disaccharoses.** (Disaccharides.) See carbohydrates.

**Disacidify.** To neutralize the acid in, or to remove it from, any mixture.

**Direct Dyes.** See dyes, substantive.

**Disazo Compound.** Any organic compound which contains two azo groups.

**Disdiaz Compounds.** Organic derivatives which contain two diazo groups, as disdiazobenzencamide,



**Disintegration.** 1. Loss of form. Powdering. 2. The passage of a metal into colloidal solution when it is made an electrode under certain conditions. 3. Transformations of radioactive elements are sometimes termed disintegrations.

**Dislocation Hypothesis.** An assumption to explain the period of induction in photochemical reactions. It states that when light acts upon a gaseous system the absorbed light produces a "dislocation" of the molecules which must reach a certain magnitude before reaction can begin.

**Disoxidation.** (Disoxygenation.) Deoxidation, reduction.

**Disperse Medium.** (Dispersive or dispersion medium, continuous phase.) The medium in which the colloid is dispersed, analogous to the solvent in a true solution.

**Disperse Particles.** (Disperse phase.) The particles of colloid in a colloidal system.

**Disperse System.** A colloidal solution.

**Dispersiodiology.** Colloid chemistry.

**Dispersion.** 1. The process of preparing a colloidal solution of a substance. 2. The separation of light into its components, producing, with white light, a spectrum.

**Dispersion, Cathode.** See Dispersion, electrical.

**Dispersion, Electrical.** The preparation of colloidal solutions by means of the electric current. Two methods are employed; 1. cathode dispersion, in which the cathode is made of the material which is to form the disperse phase, the anode is of platinum and a high potential is used; 2. passing an arc between wires of various metals under water. Many metals (Pt, Ag, Ir, Cd) give metal sols by method 2; other metals (Ti, Zn, Fe, Al) give hydroxide sols only. Metals which possess solution pressures greater than that of hydrogen are not likely to yield metal sols in water.

**Dispersion, Epipolic.** Fluorescence.

**Dispersion Medium.** See disperse medium.

**Dispersity.** The degree of dispersity of a colloid, that is, the extent to which the dimensions of the individual particle have been reduced. Expressed numerically in terms of specific surface.

**Dispersive Medium.** See disperse medium.

**Dispersive Power.** (Relative dispersion.) The ratio of the dispersion (of light) for any two colors to the deviation of the mean ray between the two.

**Dispersoids.** Colloidal systems in which the dispersity is relatively great, as in emulsoids and suspensoids.

**Dispersoid Solutions.** (Dispersoid systems.) Colloidal solutions.

**Displacement of Equilibrium.** The upsetting of a condition of equilibrium by the interference of some external influence (e.g. change of temperature) resulting in the ultimate formation of a new condition of equilibrium. See law of.

**Dissimulation of a Radical.** See radical, dissimulated.

**Dissipation.** The reduction of energy to so low a level of intensity that it cannot be utilized for the performance of work.

**Dissociation.** (To dissociate.) 1. Ionization. 2. The splitting of the molecules of certain gases when they are subjected to high temperature. At 135° nitrogen tetroxide ( $\text{N}_2\text{O}_4$ ) is nearly completely dissociated into two molecules of nitrogen dioxide ( $\text{NO}_2$ ). Phosphorus pentachloride dissociates to form a mixture of phosphorus trichloride and chlorine at high temperatures. The term dissociation is properly restricted to this splitting of gaseous molecules; electrolytic dissociation should be termed ionization. Cf. Association.

**Dissociative.** Showing a tendency to dissociate.

**Dissociation Catalysis.** The use of a catalyst to decompose one of the factors in a reaction so that one of the decomposition products may react with the second factor. In the following example the aluminic chloride acts as the catalyst: 1.  $\text{AlCl}_3 + \text{SO}_2\text{Cl}_2 = \text{AlCl}_2\text{SO}_2 + \text{Cl}_2$ . 2.  $\text{Cl}_2 + 2\text{S} = \text{S}_2\text{Cl}_2$ . 3.  $\text{AlCl}_2\text{SO}_2 \rightleftharpoons \text{AlCl}_3 + \text{SO}_2$ .

**Dissociation Constant.** See ionization constant.

**Dissociation, Degree of.** See ionization, degree of.

**Dissociation, Heat of.** See ionization, heat of.

**Dissociation in Stages.** See under ionization.

**Dissociation Pressure.** At any given temperature the pressure which exists at equilibrium between a solid and a gas formed from the solid by dissociation, as in the system solid paracyanogen-gaseous cyanogen. The pressure is a constant.

**Dissolecule.** The apparent molecular weight of a substance in solution at the boiling point of the solution.

**Dissoluble.** Soluble.

**Dissolution.** The act of solution.

**Dissolve.** To enter into solution.

**Dissolvent.** (Dissolver.) The solvent.

**Dissymmetry, Inverse.** Optical isomerism.

**Dissymmetry, Molecular.** The phenomenon of the exhibition of optical differences by isomeric molecules.

**Distill.** See distillation.

**Distillate.** That product of distillation obtained by the condensation of vaporized compounds.

**Distillation.** The process of separating volatile from non-volatile compounds by means of a vessel in which the mixture may be heated to the boiling point and a second vessel (a condenser) in which the vapors from the boiling mixture may be cooled enough to condense to a liquid which is collected in a suitable receiver. Cf. Sublimation.

**Distillation, Destructive.** The subjecting of any material in a retort or similar vessel to a temperature high enough to cause decomposition with the production of volatile products, as the destructive distillation of coal.

**Distillation, Dry.** Distillation of dry material. It may be either a case of sublimation or of destructive distillation.

**Distillation, Fractional.** A method for the separation of several volatile compounds of different boiling points so conducted as to distill the mixture at the lowest possible boiling point and collecting the distillate as one fraction

until the mixture ceases to boil at the low temperature or until the temperature of the vapor rises showing that a higher boiling compound is beginning to distill. The receiver with fraction No. 1 is disconnected at this point from the condenser and a new receiver substituted for it which collects fraction No. 2,—the next higher boiling substance. When the temperature again rises a third receiver is substituted to collect fraction No. 3 and this method is continued until the highest boiling fraction has been distilled. Constant boiling mixtures like alcohol and water cannot be separated by fractional distillation.

**Distillation in Steam.** Certain substances, notably many that are liquid at 100° and are insoluble in water, are volatile in a current of steam even though their boiling points are much higher than that of water. If these substances are heated in boiling water, or if steam is passed through a hot mixture which contains them, they volatilize and pass over with the steam and may be condensed with it in any suitable condenser. This fact is made use of in the separation of such substances from matters which are not volatile under the circumstances as in the preparation of volatile oils, purification of o-nitrophenol, etc.

**Distillation in Vacuo.** Vacuum distillation. A distillation conducted under reduced pressure so as to lower the boiling point of a volatile substance, usually resorted to to avoid the decomposition or other alteration of the substance which might occur at high temperature, or to reduce a very high boiling point to a practicable temperature.

**Distribution.** 1. Between solvents, see law of distribution. 2. Between acids or bases. When the total quantity of two (or more) acids in a solution is more than sufficient to

neutralize the amount of base present, the base will be distributed between the two acids in proportion to the ratio of the degrees of ionization of the acids. The distribution of an acid between two bases follows the same rule.

**Distribution Law, Ratio, Constant, Coefficient.** See law, distribution.

**Disulphate.** (Bisulphate.) An acid sulphate.

**Disulphide.** (Bisulphide.) A sulphide which contains two atoms of sulphur to one of base.

**Disulphuret.** Obsolete term for disulphide.

**Diuretic.** A drug which increases the secretion of urine. It may act by stimulating the functional activity of the kidneys, by raising the osmotic pressure of the blood, or by increasing blood pressure. Among the most common diuretics are the acetate and citrate of potassium, digitalis, buchu, uva ursi, and caffeine.

**Double Atoms.** The barred atoms of Berzelius.

**Double Bonds.** See bonds.

**Double Bonds, Conjugated.** See conjugated double bonds.

**Double Bonds, Cumulated.** Two double bonds which possess a carbon in common, e.g.  $R_2C : C : CR_2$ .

**Double Bonds, Isolated.** Double bonds which are neither cumulated nor conjugated.

**Double Salts.** See salts, double.

**Dram.** A unit of weight in the avoirdupois and apothecaries' systems. The liquid unit, fluidram, is often abbreviated "dram."

1 apothecaries' dram	= 60 grains.
1 " "	= 1/8 apoth.
	ounce.
1 " "	= 3.8879 grams.
1 avoirdupois " "	= 54.689 grains.
1 " "	= 3.5436 grams.
1 gram	= 0.28216 av.
	drams.
1 " "	= 0.25720 apoth.
	drams.

**Draper Effect.** When a mixture of hydrogen and chlorine is exposed to a momentary flash of light there is an expansion and an immediate contraction of the mixture to the original volume. The phenomenon is known as the Draper effect. It does not occur with the pure and dry gases according to recent research.

**Drug.** A medicinal agent. A substance used internally for the treatment of disease. The term is usually applied to materials of vegetable origin such as barks, roots, leaves, seeds, flowers, etc., medicinal agents of mineral character being termed "chemicals." Bacterial products such as serums, vaccines, bacterins, etc., are not classed as drugs.

**Drying Agents.** Substances used to absorb moisture, especially in a desiccator and in towers through which moist gases are passed. The principal drying agents are sulphuric acid, fused calcium chloride, solid potash, lime and barium oxide. (N.B. Moist air is lighter than dry air. Therefore the drying agent should be placed above the sample in a desiccator.)

**Dualistic Theory.** See theory, dualistic.

**Dutch Process for White Lead.** Sheet lead, in "buckles," is placed on a shelf in an earthenware pot five inches in diameter and eight inches high, the bottom of which contains 3% to 5% acetic acid. Carbon dioxide derived from the fermentation of spent

tan bark in which several such pots are stacked fills the air spaces while the heat from the fermentation vaporizes the acetic acid and this attacks the lead. The basic lead acetate so formed is decomposed by the moist carbon dioxide present and white lead is produced.

**Dyads.** 1. Elements whose valence is two, e.g. Ca, Mg, Zn. 2. A class of tautomeric substances characterized by the presence of two polyvalent atoms linked together between which the hydrogen travels. E.g. hydrocyanic acid is a dyad existing (in all probability) in the two dynamic isomers,—

H.C : N and C . N.H (or C : N.H).  
Cf. triads.

**Dye.** (Dyestuff.) Any substance capable of being adsorbed by fibre or of combining with it when mordanted used to impart a color to textile and similar materials. Dyes are classified as direct, mordant, substantive, adjective, monogenetic, polygenetic, natural, synthetic, mineral, etc., according to their origin and mode of application. See below.

**Dyeing.** The process of coloring fibres by means of dyestuffs.

**Dyeing, Adsorption Theory of.** An hypothesis that dyestuffs are adsorbed out of colloidal solution by fibre and that dyeing follows the laws of adsorption.

**Dyeing, Chemical Theory of.** An hypothesis which postulates a chemical combination between dyestuff and fibre.

**Dyeing, Mechanical Theory of.** An hypothesis which assumes that dyestuffs are adsorbed within the pores of the fibre.

**Dyeing, Solid Solution Theory of.** An hypothesis which supposes that the

dyestuff or mordant (when one is used) forms a solid solution in the fibre.

**Dyes, Acid.** Dyestuffs which dye animal fibre directly from an acid bath. They are of little use for vegetable fibres. E.g. nitro and azo dyes.

**Dyes, Acid Mordant.** (Acid chrome dyes.) Acid dyes which require a mordant for the best results on animal fibres.

**Dyes, Acridine.** Dyestuffs derived from acridine, chromophore  $\begin{array}{c} \text{N} \\ \diagup \quad \diagdown \\ \text{C} \end{array}$ .

**Dyes, Adjective.** (Mordant dyes.) Dyestuffs which require a mordant, as alizarine.

**Dyes, Artificial.** Synthetic dyestuffs as distinguished from natural products, ex. the coal tar colors, azo dyes, phthaleins.

**Dyes, Azine.** Dyestuffs of the chromophore  $\text{R} \begin{array}{c} \text{N} \\ \diagup \quad \diagdown \\ \text{N} \end{array} \text{R}$ .

**Dyes, Azo.** Dyestuffs the chromophore of which is the azo group, p-nitraniline red.

**Dyes, Basic.** Salts of colorless bases, e.g. auramine, malachite green, methyl violet.

**Dyes, Direct.** Substantive dyes.

**Dyes, Ingrain.** Dyestuffs produced in the fibre by successive treatment with the components of the dye, e.g. aniline black.

**Dyes, Mineral.** Inorganic compounds used in dyeing, as ferric hydrate chromic hydrate, lead chromate, prussian blue.

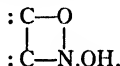
**Dyes, Monogenetic.** Dyestuffs which produce only one color on the fibre. Cf. dyes, polygenetic.

**Dyes, Mordant.** Adjective dyes.

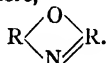
**Dyes, Natural.** Dyestuffs extracted from animal and vegetable tissues in which they are preformed or exist in combination, as indigo, alizarine, log-wood, carmine.

**Dyes, Nitro.** Dyestuffs whose chromophore is the nitro group.

**Dyes, Nitroso.** Quinoneoxime derivatives with the chromophore



**Dyes, Oxazine.** Dyestuffs with the chromophore,



**Dyes, Oxyazo.** Sulpho acid derivatives of the oxyazobenzenes, the azo group is the chromophore.

**Dyes, Oxyketone.** Dyestuffs with the chromophore,  $\text{O} : \text{C} \begin{array}{c} \diagup \quad \diagdown \\ \diagdown \quad \diagup \end{array} \text{C} : \text{O}$ .

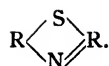
**Dyes, Polygenetic.** Dyestuffs which yield different colors on the fibre according to the mordant used, e.g. alizarine.

**Dyes, Pyronine.** Dyestuffs of the chromophore,  $\text{R} \begin{array}{c} \text{O} \\ \diagup \quad \diagdown \\ \text{C} \end{array} \text{R}$ .

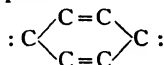
**Dyes, Substantive.** (Direct dyes.) Dyestuffs which yield colors directly to the fibre without the use of a mordant.

**Dyes, Sulphide.** Dyestuffs which dye vegetable fibre from a bath of sodium sulphide.

**Dyes, Thiazine.** Sulphur containing dyestuffs of the chromophore



**Dyes, Triphenylmethane.** Dyestuffs derived from  $(\text{C}_6\text{H}_5)_3\text{CH}$  with the chromophore



e.g. crystal violet, p-rosaniline, and methyl green.

**Dyes, Vat.** Dyestuffs which are applied to the fibre in the form of their leuco compounds, the color being later developed by oxidation.

**Dynamic Allotropy.** See allotropy, dynamic.

**Dynamic Formula.** See benzene, formulas.

**Dynamic Isomers and Isomerism.** See isomerism, dynamic.

**Dyne.** The unit of force in the c.g.s. system defined as the force which acting upon unit mass (one gram) for one second produces unit velocity (one centimeter per second).

13825.5 dynes = 1 poundal.

**Dysprosium.** Rare earth metallic element. Dy. At. Wt. 162.5. Occurs in gadolinite. Dysprosium salts are green or yellow.

**Dyslysins.** Anhydrides of biliary cholic acids produced by intestinal putrefaction, or (in vitro) by heating alone or with acids.

**Dystectic Mixture.** A mixture of two or more substances in definite proportions, of constant melting point which is the maximum melting point of any mixture of the same substances. If any of the factors are added to the mixture in any proportion the melting point is lowered. Correlative of eutectic mixture.

## E.

**Earth, Alkaline.** A term applied to the oxides of calcium, barium, and strontium, the "metals of the alkaline earths."

**Ebullition.** The phenomenon of bubble formation such as that accompanying boiling.

**Ebullioscope.** Any instrument which measures a property by a deviation from a normal boiling point. Applied to an apparatus which approximates the percentage of alcohol in a mixture by an observation on the boiling point. Beckmann's apparatus for molecular weight determination is an ebullioscope.

**Ebullioscopic Method.** The determination of the molecular weight of a substance by observing the increase in the boiling point of a solvent when a weighed quantity is dissolved therein.

$$\text{Mol. Wt.} = P \frac{d}{t},$$

where  $P$  = weight in grams in 100 grams of solvent,  $d$  = molecular rise in boiling point, and  $t$  = observed rise.

**Ecto-enzyme.** An extracellular enzyme.

**Edulcoration.** A process of purification by dissolving out soluble impurities. (Obs.)

**Effective Mobility of Ions.** The average velocity of an ion due to electric force taken over a long time and including the periods of rest, that is, when the ion is neutralized; or the average velocity of all the ions including those neutralized at the time.

**Effervesce.** } A frothing of a cold  
**Effervescence.** } or hot liquid due to the formation within it and subsequent discharge of a large number of gas bubbles. It occurs during fermentation, during the action of acids upon carbonates, etc. Boiling is not regarded as effervescence nor is the frothing produced in such actions as that of concentrated sulphuric acid upon sugar.

**Efflorescence.** The phenomenon which occurs when an hydrated solid substance, especially a crystal, parts with its solvent of crystallization or hydration and falls to an anhydrous powder. The term is also used to describe an outgrowth of saline matter upon walls and similar surfaces.

**Eka-Aluminium.** (Gallium.) An element the properties of which were predicted by Mendelejeff. The discovery of gallium confirmed the prediction.

**Eka-Boron.** (Scandium.) An element the properties of which were predicted by Mendelejeff. The discovery of scandium confirmed the prediction.

**Eka-Silicon.** (Germanium.) An element the properties of which were predicted by Mendelejeff in 1871. It was discovered in 1886 and named germanium.

**Elaeoptene.** (Elaoptene. Eleoptene. Oleoptene.) The liquid portion of an essential oil as distinguished from the stearoptene or solid which is often dissolved in it.

**Elaidin Test.** A test for acids of the oleic series and their compounds in oils which depends upon the fact that nitrous anhydride or nitrous acid converts them into solid substances known as elaidins.

**Elaimeter.** An apparatus for determining the percentage of oil in a mixture and also the purity of an oil.

**Elastic Deformation.** See piezo-electricity.

**Elasticity.** A property of bodies by virtue of which they resist deformation and resume their original form or volume when the stress ceases to act, or the ratio of the stress to the strain which it produces. For gases the formula  $E = pV/v$ , where  $E$  = elasticity,  $p$ , the increase in pressure,  $V$ , the original volume, and  $v$ , the diminution in volume, is used. Cf. modulus, Young's.

**Elayl.** Ethylene,  $C_2H_4$ .

**Electricity, Mechanical Equivalent of.** The kilowatt hour is the unit of—.

**Electricity, Negative.** 1. The kind of electricity produced on hard rubber when it is rubbed with flannel. 2. The current which flows from cathode to anode within the galvanic cell and from anode to cathode in the outside circuit.

**Electricity, Positive.** 1. The kind of electricity produced on a glass rod when it is rubbed with silk. 2. In a galvanic cell, the current which flows in the direction opposite to the negative electricity. The existence of two kinds of electricity is doubted by some who regard positive electricity as merely absence of negative electricity.

**Electro-.** A prefix which indicates that the term pertains to electricity.

**Electroaffinity.** The degree of tenacity with which the ions of an element retain their charges.

**Electroanalysis.** Analytical operations involving the use of the electric current. Many metals may be rapidly and accurately determined by depositing them on a weighed cathode and weighing the dried deposit, or they may be taken up by a mercury cathode and weighed as amalgam. Concentrations may be determined by measuring potentials and conductivities, the end-point of a titration may be determined by the use of a galvanometer in place of an indicator, and the concentration of hydrogen ions and therefore the strength of acids and bases may be determined electrolytically.

**Electrochemical Constant.** The faraday (q.v.).

**Electrochemical Equivalent.** 1. Of elements. (z.) The mass of any chemical substance liberated by one coulomb of electricity in electrolysis.  $z$  for hydrogen is 0.0001036 gram and this figure multiplied by the gram equivalent of any substance will furnish its electrochemical equivalent. 2. Of electricity. The faraday (q.v.).

**Electrochemistry.** A branch of chemistry which studies the chemical changes associated with electrical phe-

**Electrode.** 1. The means whereby the electric current gains entrance to or leaves a cell. 2. The ends of a metallic circuit between which the current travels in a medium different from the rest of the circuit are termed electrodes. The negative electrode, or cathode, is that through which the current leaves the cell; the positive electrode, or anode, is that through which the current enters the cell.

**Electrode, Dropping.** (Mercury dropping or Standard electrode.) An electrode used in measuring single potentials.



**Electrode, Normal.** An electrode of mercury in contact with a solution of potassium chloride saturated with calomel. The potential of such a system is 0.56 volt.

**Electrode of the Second Order.** An electrode of metal in contact with one of its difficultly soluble salts and in the presence of a solution of a salt which has the same anion as the less soluble salt. Ex.



They are not essentially different from an ordinary electrode in a solution of one of its salts.

**Electrode, Reversible.** An electrode which may be changed from cathode to anode and vice-versa, by reversing the direction of the current, when the chemical reactions will be exactly reversed. Thus, a zinc anode in a zinc salt solution furnishes zinc ions; let the current be reversed and zinc is deposited on the electrode which has now become a cathode.

**Electrode, Standard.** See electrode, dropping.

**Electroendosmosis.** Cataphoresis in which the solid is stationary and the water phase is displaced and migrates towards the electrode.

**Electrolysis.** The process of decomposing a chemical compound by passing a current of electricity through it either in substance, in solution, or molten. When a solution of copper sulphate is so decomposed copper appears on the cathode and sulphuric acid and oxygen at the anode.

**Electrolysis, Reversed.** Chemical combination. Since compounds are decomposed by electrolysis Armstrong considered chemical combination a reversing of that process, hence reversed electrolysis.

**Electrolyte.** Any substance whose solutions have the property of conducting the electric current. All soluble acids, bases, and salts are electrolytes. As a rule ionizable compounds are electrolytes: copper oleate is an exception.

**Electrolytic.** Pertaining to electrolysis and electrolytes.

**Electrolytic Tautomerism.** See tautomerism, electrolytic.

**Electrolyze.** To submit to the process of electrolysis; to decompose by means of an electric current.

**Electrometer.** An instrument for measuring electric potentials, especially single potentials. Ex. Lippmann's electrometer.

**Electromotive Force.** ( $\pi$ ). (E.M.F. or E.(e), Electric pressure, Potential, Potential gradient.) A difference of potential, or electrical intensity, which may cause an electric flow through a circuit against a resistance. The E.M.F. in any circuit may be calculated when the current strength ( $i$ ) in amperes, and the resistance ( $R$ ) in ohms are known, by the formula,

$$E \text{ (volts)} = iR.$$

**Electron.** A corpuscle carrying an electric charge, possibly the electric charges themselves. The mass of negative electrons is  $1/1700$  the mass of the hydrogen atom and their velocity may rise to 90,000 miles per second. Positive electrons appear to be much larger than the negative and each carries the same charge as a univalent ion.

**Electron Theory of Matter.** Any one of several hypotheses which postulate that the atoms are constituted of electrons in varying numbers and arrangement in various elements.

**Electronic.** Pertaining to or carrying electrons.

**Electrons, Metastatic.** Electrons which change their positions in the atom.

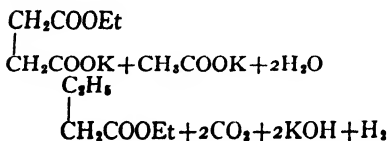
**Electronegative.** Elements and radicals which bear a negative electric charge. In electrolysis they are deposited on the anode.

**Electroplating.** (Electrodeposition.) The process of depositing a smooth, homogeneous coating of a metal or mixture of metals upon a metallic or a conducting surface by means of electrolysis. Nickel, copper, zinc, brass, silver, and gold are the metals commonly deposited.

**Electropositive.** Elements and radicals which bear a positive charge. In electrolysis they are deposited on the cathode.

**Electrostriction.** The phenomenon of the contraction of a solvent due to the electrostatic field in a dissolved electrolyte.

**Electrosynthesis.** The effecting of synthetical reactions by means of the electric current. The electrolysis of a mixture of potassium acetate and K ethyl succinate yields ethyl butyrate, viz.,



This type of reaction might well be termed electrocondensation.

**Element.** 1. Any one of about eighty substances of which all compounds are formed and which are, themselves, undecomposable by ordinary methods of analysis into other elements. The phenomena of radioactivity appear to indicate that what are now termed elements are, in reality, complexes formed of electrons.

An "element" having been proved complex ceases, ipso facto, to be elementary. 2. A galvanic cell.

Table of Elements.

o = 16. (1920)

Aluminium,	Al,	27.1
Antimony,	Sb,	120.2
Argon,	A,	39.9
Arsenic,	As,	74.96
Barium,	Ba,	137.37
Bismuth,	Bi,	208.0
Boron,	B,	10.9
Bromine,	Br,	79.92
Cadmium,	Cd,	112.40
Caesium,	Cs,	132.81
Calcium,	Ca,	40.07
Carbon,	C,	12.005
Cerium,	Ce,	140.25
Chlorine,	Cl,	35.46
Chromium,	Cr,	52.0
Cobalt,	Co,	58.97
Columbium,	Cb,	93.1
Copper,	Cu,	63.57
Dysprosium,	Dy,	162.5
Erbium,	Er,	167.7
Europium,	Eu,	152.0
Fluorine,	F,	19.0
Gadolinium,	Gd,	157.3
Gallium,	Ga,	70.1
Germanium,	Ge,	72.5
Glucinum,	Gl,	9.1
Gold,	Au,	197.2
Helium,	He,	4.00
Holmium,	Ho,	163.5
Hydrogen,	H,	1.008
Indium,	In,	114.8
Iodine,	I,	126.92
Iridium,	Ir,	193.1
Iron,	Fe,	55.84
Krypton,	Kr,	82.92
Lanthanum,	La,	139.0
Lead,	Pb,	207.20
Lithium,	Li,	6.94
Lutecium,	Lu,	175.0
Magnesium,	Mg,	24.32
Manganese,	Mn,	54.93
Mercury,	Hg,	200.6
Molybdenum,	Mo,	96.0
Neodymium,	Nd,	144.3
Neon,	Ne,	20.2

Nickel,	Ni,	58.68
Niton,	Nt,	222.4
Nitrogen,	N,	14.008
Osmium,	Os,	190.9
Oxygen,	O,	16.00
Palladium,	Pd,	106.7
Phosphorus,	P,	31.04
Platinum,	Pt,	195.2
Potassium,	K,	39.10
Praseodymium,	Pr,	140.9
Radium,	Ra,	226.0
Rhodium,	Rh,	102.9
Rubidium,	Rb,	85.45
Ruthenium,	Ru,	101.7
Samarium,	Sa,	150.4
Scandium,	Sc,	44.1
Selenium,	Se,	79.2
Silicon,	Si,	28.3
Silver,	Ag,	107.88
Sodium,	Na,	23.00
Strontium,	Sr,	87.63
Sulphur,	S,	32.06
Tantalum,	Ta,	181.5
Tellurium,	Te,	127.5
Terbium,	Tb,	159.2
Thallium,	Tl,	204.0
Thorium,	Th,	232.15
Thulium,	Tm,	168.5
Tin,	Sn,	118.7
Titanium,	Ti,	48.1
Tungsten,	W,	184.0
Uranium,	U,	238.2
Vanadium,	V,	51.
Xenon,	X,	130.2
Ytterbium,	Yb,	173.5
Yttrium,	Yt,	89.33
Zinc,	Zn,	65.37
Zirconium,	Zr,	90.6

**Element, Alkaline.** Any one of the metals of the alkalis, potassium, sodium, lithium, caesium, or rubidium.

**Elements, Bridge.** (Group elements.) The elements in the first short series in the periodic table, Helium to Fluorine, so called because they show a "notable gradation of properties from one to the other."

**Elements, Devolution of.** The disintegration of the elements, i.e. such as occurs in radioactive substances.

**Elements, Evolution of.** The formation of complex elements, those of high atomic weight, from simpler elements of low atomic weight. The process is assumed to be now taking place as the elements which appear in the hottest stars are those of low atomic weight while, as the stars cool, other elements of higher atomic weight appear.

**Elements, Extinct.** Elements of high atomic weight and, by inference, of complex atomic structure, which may formerly have existed upon the earth and have now completely degraded into simpler elements.

**Elements, Gaseous.** The gaseous elements are argon, chlorine, fluorine, helium, hydrogen, krypton, neon, nitrogen, oxygen, and xenon.

**Elements, Group.** See elements, bridge.

**Elements, Normal.** Standard galvanic cells. The commonest are the Helmholtz calomel cell, the Clark cell, and the Weston or cadmium cell.

**Element, Primal.** (Pantogen. Urstoff. Protyle.) An hypothetical element assumed to be the homogeneous, simple, primal form of matter from which all other elements have been formed.

**Elements, Theory of Four.** The doctrine of the ancient philosophers that the world is composed of four elements, air, fire, earth, and water, to which later philosophers added a fifth, the quintessence.

**Elements, Transitional.** Elements which occupy the middle position in the long periods or form group VIII in the periodic classification, i.e. iron, cobalt, nickel, ruthenium, rhodium, palladium, etc.

**Elements, Typical.** In the periodic system, the elements in series 3, (neon

to chlorine) which show the typical properties of the group. From them the groups divide into two sub-groups.

**Elution.** A process for the recovery of sucrose from molasses. Quicklime in the proportion of 25% of the weight of the molasses is added, the resulting mass is freed from much impurity by percolating (in "elutors") with 35% alcohol and is then decomposed by carbon dioxide which liberates the

**Emanation.** A gaseous substance given off from radioactive material. The radium emanation has a half period of 3.8 days, emits alpha rays, and is transformed into radium A. It has been termed Niton (Nt) with an atomic weight of 222.4. It decomposes spontaneously into helium and a radioactive solid. All emanations possess the power to ionize gases, i.e. to make them conductors of an electric current.

**Emissive Power.** The intensity of radiation of given wave-length emitted at a given temperature.

**Empirical Formula.** A formula which states only the constituent elements of a substance and their relative proportions and gives no information as to molecular weight or constitution.  $\text{CH}_2\text{O}$  is the empirical formula of dextrose. Cf. Formula.

**Empyreuma.** A thick, brownish, acid oil mixed with water produced by the destructive distillation of animal or vegetable matter. Its composition varies according to the source. Wood, bones, blood, tobacco, etc., yield empyreumatic oils.

**Empyreumatic Oils.** Empyreumas. The term is used to distinguish them from the essential oils.

**Emulsion.** A suspension of one liquid in another with which it is

immiscible. Extended to include permanent suspensions of solids in liquids. Proctor termed emulsions positive when water is the continuous phase and negative when it is the disperse phase. In colloid chemistry the term emulsoid is used for emulsions where the dispersity is high.

**Emulsoids.** See emulsions.

**Enantiomorphs.** Crystals which possess neither a plane nor a center of symmetry and cannot be brought into coincidence with their reflected image. They are distinguished as right and left forms and commonly exhibit optical activity, the right and left forms rotating the ray of polarized light in opposite directions. Cf. Isomerism, optical.

**Enantiomorphous.** Substances which exist in optically active modifications and crystallize as enantiomorphs.

**Endochrome.** The coloring matter, of whatever color, within the cells of a plant.

**Endocyclic Compounds.** Unsaturated cyclic derivatives in which the double bond occurs in the nucleus.

**Endoenzyme.** An intracellular enzyme.

**Endosmosis.** Osmosis in which the solvent dialyzes into the system. *Exosmosis* is the reverse process. The two may be illustrated by the conditions in the living cell; when the plasma is hypertonic solvent passes from the cell into the plasma and we have exosmosis; when the plasma is hypotonic the solvent passes from the plasma into the cell and we have endosmosis.

**Endothermal.** } Terms which denote  
**Endothermic.** } absorption of heat.  
Endothermal reactions absorb heat as they progress. An endothermal cell

is such that the production of a current is attended by an absorption of heat.

**Energy.** The power to overcome resistance. That which has the power of changing the properties of bodies. Energy is indestructible. It is manifested as heat, light, electricity, and chemical change.

**Energy, Available.** Free energy.

**Energy, Chemical.** A form of energy which manifests itself in chemical transformations. It may be divided into two factors: the intensity factor is chemical affinity or chemical potential; the capacity factor is the equivalent weight or the active mass of substance.

**Energy, Cohesion.** The energy a body possesses by virtue of the tendency of its particles to approach one another.

**Energy, Disgregation.** The energy a body possesses by virtue of the tendency of its particles to recede from one another.

**Energy, First Law of.** See law of conservation of energy.

**Energy, Form.** Elasticity.

**Energy, Free.** Available energy. That portion of the total energy associated with any body which can be utilized for doing work.

**Energy Isomerism.** Dynamic isomerism. See Isomerism, dynamic.

**Energy, Kinetic.** Energy possessed by a moving body by virtue of its motion. It is proportional to half the mass ( $M$ ) of the body into the square of its velocity ( $V$ ), or, K.E. =  $MV^2/2$ .

**Energy, Potential.** Energy possible to a body by virtue of its position. It is stored in the body and may be recovered in measurable form. Water

in an elevated place, gunpowder, compressed air, all possess potential energy.

**Energy, Radiant.** A form of energy propagated in definite wave-lengths at a velocity of  $3 \times 10^{10}$  cm. per second. Radiant energy has neither intensity nor capacity factors and appears to be electromagnetic in nature. It is readily transformed into other forms of energy, especially chemical energy (photo-chemical processes). The main source of radiant energy is the sun.

**Energy, Second Law of.** See law of the degradation of energy.

**Energy, Specific Density of.** The energy in unit space.

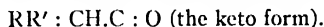
**Energy, Thermal.** Heat energy.

**Energy, Volume.** Energy due to volume change.

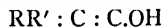
**Enfleurage.** A process for the extraction of volatile oils and odoriferous substances from plants. The plants or flowers are spread on glass plates which have been coated with grease, vaseline, or glycerin, that absorbs the oils. These are then extracted from the absorbent by alcohol.

**Enhydrous.** Anhydrous.

**Enol Form.** One of two tautomeric forms of a substance of the general type



The enol form is formed from the keto by migration of hydrogen from the adjacent carbon atom to the carbonyl group producing the type



Cf. Isomerism, dynamic.

**Ens.** An essence. (Obs.)

**Entropy.** (S.) ("The thermodynamic function.") A factor of the unavailable energy in a thermodynamic process, proportional to the total amount of heat ( $Q$ ) delivered to a system and inversely proportional to the initial temperature ( $T$ ). Where  $A$  is the work,

$$dA = Q \frac{dT}{T}.$$

The entropy factor is always negative. The total unavailable energy of a process is the product of the entropy into the lowest available temperature. At the absolute zero entropy vanishes. Entropy may be compared to interest on borrowed money; it is waste incurred in utilizing energy.

**Enzymes.** Substances produced by living cells which have the power to catalyze chemical reactions, one specific enzyme rarely catalyzing more than one type of reaction. The composition of the enzymes is unknown but they are probably organic compounds related to the proteins. Enzymes are named usually according to the type of action they influence, the suffix "ase" being added as characteristic of this class of substances. Representative enzymes are diastase, lipase, catalase, and oxidase. Pepsin, trypsin, rennin, emulsin, and erepsin are enzymes which were named before the general use of the suffix ase. Enzymes are also termed ferments, and unorganized ferments.

**Enzymes, Autolytic.** 1. Proteolytic and carbohydrate splitting enzymes present in living cells and capable of digesting the cells themselves under favorable circumstances. 2. Enzymes which act without external stimulation.

**Enzymes, Deamidizing.** Enzymes which catalyze the metabolizing of amino acids into ammonium compounds.

**Enzymes, Exocellular.** (Extracellular enzymes.) Enzymes which may readily be isolated from association with living cells. Pepsin, maltase, zymase. Cf. enzymes, intracellular.

**Enzymes, Glycolytic.** See enzymes, sucroclastic.

**Enzymes, Hydrolytic.** Enzymes which catalyze hydrolysis. Pepsin, maltase, emulsin, invertase.

**Enzymes, Inorganic.** See ferments, inorganic.

**Enzymes, Intracellular.** Enzymes which have not yet been separated from association with living matter.

**Enzymes, Inverting.** Enzymes which catalyze the inversion of cane sugar. Invertin.

**Enzymes, Lipolytic.** (Lipases. Steatolytic.) Enzymes which catalyze the hydrolysis of fats.

**Enzymes, Proteolytic.** (Proteases. Proteoclastic enzymes.) Enzymes which catalyze the hydrolysis of proteins. Pepsin, papain.

**Enzymes, Sucroclastic.** (Glycolytic enzymes.) Enzymes which split sugars.

**Enzymes, Uricolytic.** Enzymes which catalyze the metabolizing of uric acid to urea.

**Enzymolysis.** } Terms applied to any  
**Enzymosis.** } reaction catalyzed  
by an enzyme.

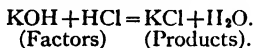
**Epi-.** A prefix denoting a position in the naphthalene nucleus; see naphthalene.

**Epiphyte.** A non-parasitical plant which grows attached to another plant.

**Eporose.** Lacking pores.

**Epipolic Dispersion.** } Fluorescence,  
**Epipolism.** } q.v.

**Equation, Chemical.** A symbolic expression of a chemical reaction in which the formulas of the factors are set equal to the formulas of the products, the interaction of the factors being indicated by plus signs. The relative weights of the factors and products is also indicated, i.e.



**Equation, Gibbs-Helmholtz.** An equation by means of which one may calculate the heat of reaction in a cell by measuring the potential at two or more temperatures:

$$Q = C(E - T \cdot dE/dT).$$

where  $Q$  is heat of reaction,  $C$ , quantity of electricity conveyed,  $E$ , potential of cell, and  $T$ , the absolute temperature.

**Equation, Van der Wall's.** (Characteristic equation.)

$$(P + a/v^2)(v - b) = RT,$$

where  $P$  is the pressure,  $v$ , volume,  $b$ , co-volume of the molecules of the gas,  $a$ , a constant referring to the calculated molecular attraction of the gas,  $R$ , the gas constant, and  $T$ , the absolute temperature.

**Equilibrium.** A condition where all the forces or tendencies present are exactly counterbalanced or neutralized by equal and opposite forces and tendencies. In chemical theory especially applied to reversible reactions in which case equilibrium is reached when the velocity of the "opposing" reaction, i.e. the interaction of the products to regenerate the factors, equals the velocity of the first reaction. There is no apparent reaction taking place in the system at this point yet it is believed that both reac-

tions proceed indefinitely with the same velocity.

**Equilibrium, Apparent.** (False equilibrium.) A condition of apparent equilibrium in a system which is brought about by the interference of some factor (usually accidental) which prevents the system proceeding to a true equilibrium. Often the interfering factor is a great diminution in the velocity of one of the reactions.

**Equilibrium, Displacement of.** See law of.

**Equilibrium, Heterogeneous.** (Polyphase equilibrium.) Equilibrium between two or more phases, as between a solid and a gas, or a liquid and its saturated vapor. The system calcium oxide—carbon dioxide furnishes an heterogeneous equilibrium.

**Equilibrium, Homogeneous.** Equilibrium conditions in a system which constitutes a single phase, i.e. reaction in solution or among gases the products of which remain in the same phase as the factors.

**Equilibrium Isothermal.** An equilibrium equation for constant temperature.

**Equilibrium, Metastable.** False equilibrium.

**Equilibrium, Order of.** A method of classifying equilibria. Equilibrium of the *first order* embraces cases where only one component is present; E. of the *second order* embraces two-component systems and so on for higher orders.

**Equilibrium, Polyphase.** Heterogeneous equilibrium.

**Equivalence.** Valence.

**Equivalent.** 1. The atomic weight of an element divided by its valence.  
 2. The molecular weight of a compound divided by the valence of its cation.

## EQUIVALENT

3. A term applied to radicals which have equal combining powers.

**Equivalent Conductivity.** See conductivity.

**Equivalent, Electrochemical.** See electrochemical equivalent.

**Equivalent, Gram.** See gram-equivalent.

**Equivalent Normal Solutions.** See solutions, volumetric.

**Equivalent, Toxic.** The minimum lethal dose. The smallest amount of a poisonous substance needed to kill one kilogram of animal.

**Equivalent Weight.** 1. The atomic weight. 2. A gram-equivalent. 3. In a series of compounds of similar type, i.e. hydroxides, the relative weights which effect the same chemical results, e.g. neutralization of some acid.

**Erbium.** Rare earth metallic element. Er. At. Wt. 167.7. S. G. 4.77. Valence 3. Oxide  $\text{Er}_2\text{O}_3$ . Occurs in samarskite, gadolinite and other rare minerals.

**Erg.** The unit of work in the c.g.s. system, defined as the work done when a body acted upon by a force of one dyne moves through one centimeter in the direction of the force.

$$1 \text{ Joule} = 10^7 \text{ ergs.}$$

$$1 \text{ Foot-poundal} = 4.214 \times 10^5 \text{ ergs.}$$

**Eremacausis.** Slow combustion or oxidation such as the rusting of iron, decay of wood, or oxidation of phosphorus in air.

**Erlenmeyer's Rule.** A free hydroxyl group usually adds to a carbon atom in double union with its neighboring carbon atom. When intramolecular atomic rearrangements occur the hydrogen of the hydroxyl migrates to the adjacent carbon atom and the

## ESTERS

hydroxyl oxygen unites doubly with the first carbon atom. Ex.



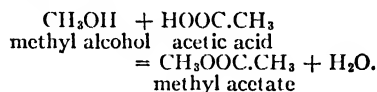
bromethylene vinyl alcohol      acetaldehyde.

**Erythrogen.** A term applied to any one of several substances which may yield blood-red compounds through the action of some reagent. (Obsolescent.)

**Erythronium.** An obsolete name for vanadium.

**Essence.** 1. A proximate principle of a plant. 2. An alcoholic solution of the volatile constituents of a plant. A spirit.

**Ester.** (Compound ether. Ethereal salt.) A compound formed from an alcohol and an organic or inorganic acid by the elimination of water. The alcohol residue takes the position assumed by cations in the inorganic salts. Ex.



The nomenclature of the esters is similar to that of the inorganic salts; they are named as if they were salts of the alcohol radicals.

**Ester Number.** A constant of a fat or wax. It depends upon the amount of alkali needed to saponify the esters in a given fat and is equal to the saponification number and the acid number.

**Esters, Acid.** (Ether acids.) Esters of polybasic acids in which only part of the hydrogen atoms have been replaced by alcohol radicals.

**Esters, Basic.** Esters of polyhydric



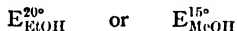
alcohols in which only part of the hydroxyl hydrogens have been replaced by acid radicals, e.g.  $\alpha$  chlorhydrin,  $\text{CH}_2\text{OH}.\text{CHOH}.\text{CH}_2\text{Cl}$ .

**Esters, Neutral.** Esters of polybasic acids in which all the acidic hydrogens have been replaced by alcohol radicals.

**Esteric Hindrance.** Same as steric hindrance.

**Esterification.** The process of converting an acid into an alkyl or aryl salt or ester. Dehydrating and catalytic agents are often used to bring about the reaction, e.g. sulphuric or hydrochloric acid; or the acyl chloride may be added to the alcohol when hydrochloric acid is split out and the ester is formed.

**Esterification Constant.** (E.) A constant which depends upon the velocity of the esterification of an acid dissolved in an alcohol in presence of N/20 alcoholic hydrochloric acid. As the reaction velocity varies with the temperature and the alcohol employed the constant is qualified thus:



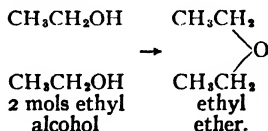
**Ethanolysis.** Alcoholysis in which the alcohol split is ethyl alcohol.

**Ethenoid.** Containing an ethenc or ethylene linkage.

**Ethenyl.** The radical  $\text{CH}_2\text{C} \cdot$

The name ethenyl is also applied to vinyl,  $\text{CH}_2 : \text{C} \cdot$ .

**Ether.** A compound derived from two alcohol molecules by the elimination of water.



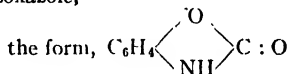
Ethers in which the alcohol radicals are identical are termed simple ethers; those in which they are different are mixed or complex ethers.

**Ether, The.** (Luminiferous ether. Aether.) An hypothetical medium postulated to pervade all space and to permeate all matter, of enormous elasticity, offering no resistance to the passage of bodies through it but capable of resisting a shearing stress. Considered the medium for the transmission of light through space.

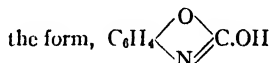
**Ether Acids.** See esters, acid.

**Ether, Compound.** (Complex ether.) An ester.

**Ethers, Lactam.** Derivatives of one of the tautomeric forms of  $\mu$ -oxybenzoxazole,



**Ethers, Lactime.** Derivatives of a tautomeric form of  $\mu$ -oxybenzoxazole,



**Ethereal Oil.** A volatile oil.

**Ethereal Salt.** An ester.

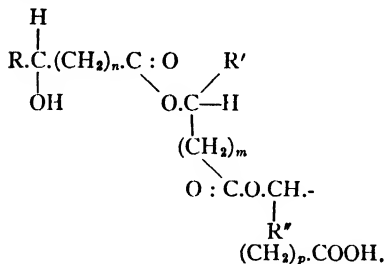
**Ethereous Oil.** A volatile oil.

**Etherification.** The process of manufacturing ethyl ether, and, by extension, the process of preparing any ether.

**Ethide.** A compound of a metal and the radical ethyl, as zinc ethide,  $\text{Zn}(\text{C}_2\text{H}_5)_2$ . The ethides may be regarded as ethane in which one hydrogen atom has been substituted by a univalent metal.

**Etholides.** Wax-like substances present in certain conifers. They are

esters, acids, and alcohols and all their saponification products are acids, none being purely alcoholic. The suggested general formula is:



**Ethyl.** The radical  $\text{CH}_3\text{CH}_2\cdot$  or  $\text{C}_2\text{H}_5\cdot$ .

**Ethylate.** 1. A compound formed by replacing the hydroxyl hydrogen of ethyl alcohol by a metal, viz. sodium ethylate,  $\text{C}_2\text{H}_5\text{ONa}$ . In properties the ethylates resemble the hydroxides. 2. To alkylate with the ethyl group.

**Ethylation.** A type of alkylation in which the ethyl group is introduced into a molecule.

**Euchlorine.** The product of the action of concentrated hydrochloric acid upon potassium chlorate. Davy thought it to be chlorine trioxide, but it has since been shown to be a variable mixture of chlorine and chlorine peroxide.

**Eudiometer.** A graduated tube closed at one end in which two platinum wires are sealed so that a spark may be passed through the contents of the tube. Used to measure the volume changes in the combustion of gases.

**Eudiometry.** Gas analysis.

**Europium.** Rare earth metallic element. Eu. At. Wt. 152. Valence 3. Oxide  $\text{Eu}_2\text{O}_3$ .

**Eutectic Mixture.** A mixture of two (or more) substances in definite proportions which melts at a lower temperature than any other mixture of the same factors in different proportions. The melting point is constant and the mixture is comparable to constant boiling mixtures of liquids. Cryohydrates are eutectic mixtures. Cf. Dystectic.

**Eutexia.** A general term for eutectic phenomena.

**Evaporation.** The process of evaporating.

**Evaporate.** 1. To convert into gas or vapor, especially if done slowly. The evaporation of solids is best termed sublimation. 2. To concentrate a solution by removing the solvent as gas.

**Evaporation, Heat of.** The heat absorbed in converting a liquid into vapor at the same temperature. Numerically equal to the heat evolved in the reverse process which may be called the heat of condensation. The heat of evaporation of solids is best termed their heat of sublimation. Called also the latent heat of evaporation and heat of vaporization, q.v.

**Evaporation, Molar Heat of.** See vaporization, molecular heat of.

**Evaporation, Spontaneous.** Evaporation at ordinary temperature.

**Evolution Apparatus.** Any form of apparatus used in gas analysis in which a gas may be set free from a measured amount of substance, collected, and directly measured. Nitrometers, azotometers.

**Excess.** In chemical texts used to denote a larger proportion of one factor than is (stoichiometrically) needed to neutralize, combine with, decompose, or precipitate another factor in a reaction.

**Excess Voltage.** (Excess potential. Supertension.) The difference between the potential actually necessary to bring about an electrolysis and the potential difference between electrodes made of the products. The oxygen anode is 1.11 volt positive to the hydrogen cathode but to bring about the electrolysis of water, using platinum electrodes, 1.79 volts difference of potential is necessary, 0.68 volt being the excess voltage.

**Exocyclic Compounds.** Unsaturated cyclic derivatives in which the double bond occurs in the side chain.

**Exosmosis.** See endosmosis.

**Exothermal.** } Terms which denote  
**Exothermic.** } evolution of heat.  
 Cf. endothermal.

**Exothermic Compounds.** Compounds which are formed from their elements with evolution of heat.

**Exothermic Reactions.** Reactions which evolve heat as they progress.

**Expansion, Coefficient of Linear.** ( $\alpha$ .) The change in the length of an expanding body per length per degree, or

$$\alpha = \frac{L_2 - L_1}{L_1(t_2 - t_1)}$$

where  $L_1$  equals the length at  $0^\circ \text{C.}$ ,  $L_2$ , the observed length,  $t_1$ ,  $0^\circ$ , and  $t_2$ , the observed temperature. The formula  $L_t = L_0(1 + \alpha t)$  gives the length at any temperature.

**Expansion, Modulus of.** The  $K$  in Mendeleeff's formula for the expansion of liquids,

$$V = V_0/I - Kt.$$

**Expectorants.** Remedies which increase or modify the secretions of the pulmonic mucous membrane.

**Experiment.** An operation conducted for the purpose of determining some unknown fact or of obtaining knowledge concerning a general principle or truth.

**Explosion.** See detonation.

**Explosion, Heat of.** The amount of heat (in calories) developed by the explosion of one gram of an explosive mixture.

Nitroglycerin, 1459 cal.  
 Gun cotton, 1010.

**External Compensation.** See compensation, external.

**Exsiccation.** Desiccation.

**Extract.** The material extracted from a plant by a solvent. Specifically the total solids in a liquid of organic nature, as the extract in a tincture or wine.

**Extraction.** A process of separating certain substances from mixtures usually by means of solvents, as the extraction of the soluble matters from a drug by percolation.

**Extractive.** Soluble material mixed with insoluble from which it may be extracted by suitable solvents.

## F.

**Fact.** In science, a circumstance that has been confirmed by at least two independent investigators by experiment.

**Factitious.** Not produced by natural process.

**Factor.** (Reactant.) A component. Any one of the substances which take part in a chemical reaction. A numerical quantity or a unit which, in mathematical combination with other units or numerical quantities, expresses the components of another quantity or unit.

**Factor, Van't Hoff's.** See reaction isotherm and isochore.

**Fahrenheit.** (F.) A method of dividing the thermometric scale devised by Fahrenheit (1686-1736), in which the melting point of water is 32 degrees and its boiling point 212 degrees. (See thermometer.)

**Falcate.** (bot.) Shaped like a scythe, as a leaf of certain species of plants.

**False Peroxides.** Oxides into which the oxygen does not enter as whole molecules. Cf. holoxides.

**Family.** 1. A group of elements characterized by similar chemical properties such as valence, solubility of salts, behavior toward reagents, etc. The alkali family includes sodium, potassium, lithium, caesium, and rubidium. The alkaline earth family consists of calcium, strontium, and barium, and the nitrogen family of nitrogen, phosphorus, arsenic, antimony, and bismuth. 2. A genus.

**Farad.** The name of the practical electromagnetic unit of capacity. It is defined as that capacity which is charged to a difference of potential of one volt by one coulomb. The microfarad ( $10^{-6}$  farad) is the unit in common use. Cf. faraday.

**Faraday.** (F.) The quantity of electricity which can deposit one electrochemical equivalent in grams, equal to 96,540 coulombs. Cf. farad.

**Faradic.** Electric currents produced by certain forms of high frequency apparatus.

**Faradization.** Therapeutic use of induced currents.

**Farinaceous.** Vegetable material which contains starch.

**Fat.** The glyceryl ester of a higher "fatty" acid such as stearic, palmitic, and oleic acids. The term is not narrowly limited for it is indefinite which aliphatic acid forms the fat of lowest molecular weight. Glycerides of such unsaturated acids as linoleic are often considered fats. The hydrolysis of fats by means of caustic alkalis is termed saponification.

**Fatty Acids.** The members of the saturated monocarboxylic aliphatic acid series of the general formula  $C_nH_{2n+1}.COOH$ , homologues of acetic acid. So called because the higher members of the series occur in natural fats.

**Fatty Series.** The aliphatic series of organic compounds.

**Ferment.** An enzyme.

**Fermentation.** The process in which organic substances undergo a variety of changes due to the activity of certain living organisms or of substances derived from animal or vegetable sources, called ferments or enzymes. Formerly applied to all chemical processes in which a gas is evolved. See enzyme, yeast, and alcoholic fermentation.

**Ferment Oils.** Volatile oils produced by the fermentation of plant material in which the oils are not preexistent.

**Ferments, Inorganic.** Colloidal solutions of the metals which act catalytically very similar to organic ferments, show analogous changes of activity by time and temperature, and whose activity is destroyed by substances which render the enzymes inert.

**Ferment Oxide.** (Ferment peroxide.) An hypothetical compound of a catalase with hydrogen peroxide assumed to be formed as an intermediate product in the decomposition of peroxides by those enzymes.

**Fermentation Selective.** Biochemical resolution of inactive compounds, q.v.

**Ferri-.** A prefix indicating content of ferric iron, as in ferricyanide.

**Ferric.** A salt of iron in which the metal is trivalent.

**Ferro-.** A prefix indicating content of ferrous iron, as in ferrocyanide.

**Ferrous.** A salt of iron in which the metal is divalent.

**Fertilizers.** Substances added to soils to replace plant-foods abstracted from the soil by vegetation, or as in sandy soil, to furnish nutritive material for plant life. They may be classified as, Natural fertilizers, e.g. manure,

urine, vegetable compost; and Artificial fertilizers, e.g. ammonium salts, nitrates, potassium salts, phosphates, nitrolime, etc.

**Filament.** (bot.) That portion of a stamen which supports the anther.

**Filiform.** (bot.) Thread shaped.

**Filter.** 1. A porous septum or strainer employed to separate undissolved matter from liquids. 2. To submit to filtration.

**Filtration.** The process of separating a liquid phase from solid phases suspended in it by straining out the solids.

**Filter, Berkfeld.** An apparatus for filtration made of porous earthenware used to strain out minute particles such as bacteria.

**Filter, Light.** An apparatus capable of absorbing rays of certain wavelength so that light which has passed through it is qualitatively modified.

**Filtrate.** A liquid which has been strained through a filter.

**Firedamp.** Methane. Mixed with air it forms an explosive gas. It occurs in some coal mines and has caused much damage.

**First Law.** (First law of energy, of energetics, of thermodynamics.) See law of conservation of energy.

**Fittig's Synthesis.** See reaction, Fittig's.

**Fixed Air.** Black's name for carbon dioxide.

**Fixed Configuration.** A condition in which it is supposed that the radicals in carbon compounds are fixed in their relative positions and do not oscillate.

**Fixed Bodies.** Difficultly volatile substances; stable compounds. (Obs.)

**Fixed Oils.** The fatty or non-volatile oils, e.g. olive, linseed, castor oils, etc.

**Flash Point.** 1. Of explosive mixtures. The minimum temperature which will enable combustion or explosion to take place. 2. Of oils, the minimum temperature at which the vapor of an oil will ignite.

**Flint Glass.** (Potash-lead glass.) A tough, easily fusible glass which contains lead silicate with silicates of alkaline metals, usually potassium.

**Flints, Liquor of.** A solution of silica (or flints) in potash.

**Float.** A small balloon of glass used in a burette to facilitate reading.

**Floating Linkage.** A term proposed by Knorr to express the "oscillation" of an hydrogen atom between two nitrogen atoms as in phasotropy, q.v.

**Flocculent.** Woolly. Occurring in indefinite masses like locks of wool.

**Florescent.** (bot.) Blossoming.

**Fluorescence.** (bot.) The flower or blossom of a plant.

**Fluid.** A portion of matter which is unable to support a steady longitudinal stress without lateral support. A gas or liquid.

**Fluo-.** } Prefixes indicating content  
**Fluor-.** } of fluorine, as fluoben-  
**Fluoro-.** } zene, fluorchloroform.

**Fluorescence.** (Epipolism, epipolic dispersion.) A property possessed by certain substances of absorbing radiant energy of definite wave-length and of emitting it as waves of greater length, characteristic of the substance. The phenomenon ceases when the illumination is cut off (difference from phosphorescence). Chlorophyll solutions show a red fluorescence, quinine sul-

phate solutions a pale blue, fluorspar a violet. Cathode and roentgen rays produce strong fluorescence.

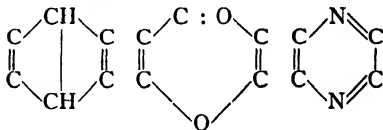
**Fluoric.** Containing or derived from fluorine.

**Fluoride.** A salt of hydrofluoric acid,  $\text{H}_2\text{F}_2$ , as calcium fluoride,  $\text{CaF}_2$ .

**Fluorine.** Gaseous element. F. At. Wt. 19. M. Wt. 38. S. G. 1.31 (Air = 1). S. G. of liquid fluorine, 1.14. M. P.  $-223^\circ\text{C}$ . B. P.  $-187^\circ\text{C}$ . Valence 1. Occurs in cryolite and fluorspar. The most active element known. Acid,  $\text{H}_2\text{F}_2$ .

**Fluorogens.** Groups which transform a luminescent property into a fluorescent property. They correspond to the chromophores.

**Fluorophores.** According to R. Meyer, a number of ring complexes which confer the property of fluorescence. Some of these are,



**Fluosilicates.** Salts of the bivalent hydrofluosilicic acid  $\text{H}_2\text{SiF}_6$ . The potassium and barium salts are difficultly soluble in water.

**Flux.** 1. Any substance used to facilitate the fusion of a metal or mineral, as borax, lime, or fluorite. 2. The quantity of a force which passes through unit area in a given time.

**Foliate.** (bot.) Having leaves.

**Foot, Cubic.** A measure of volume in the English system.

1 cu. ft. = 0.02832 cu. meter.  
1 cu. ft. = 1728 cu. inches.  
1 cu. meter = 35.314 cu. ft.

**Foot Pound.** A unit of work defined as the work necessary to lift a pound mass through a distance of one foot against the force of gravity.

**Foot Poundal.** A unit of force, defined as the force that produces an acceleration of one foot per second per second in a mass of one pound.

**Foot, Square.** A unit of area in the English system.

1 sq. ft. = 0.0929 sq. meters.

1 sq. ft. = 144 sq. inches.

1 sq. meter = 10.764 sq. ft.

**Force.** That which tends to produce a change in motion in a body upon which it acts. It is measured by the time rate of change of momentum or the product of the mass ( $m$ ) and the acceleration conferred upon the mass ( $a$ ),

$$F = (mv - mv_0)/t = ma.$$

The unit of force is the dyne.

**Force, Catabiotic.** Energy derived from the metabolism of food.

**Force, Catalytic.** See catalysis.

**Force, Centrifugal.** In uniform circular motion, the reaction of a moving body against being pulled out of a straight line. It is measured by the product of the mass times the acceleration,

$$F = m(v^2/r),$$

where  $m$  is mass,  $v$ , velocity, and  $r$ , the radius of the circle described by the moving body. The force required to counteract centrifugal force and to continue the body in circular motion is known as "centripetal" force.

**Force, Vital.** Force inherent in and characteristic of living organisms. It was formerly considered that vital force modified the chemical reactions of the organism and produced compounds which could not be synthesized without its aid. This view has been

thoroughly disproved especially by organic chemistry which has synthesized, in vitro, a large number of the products of living cells.

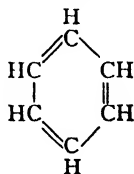
**Formation, Heat of.** The heat absorbed or evolved during the formation of unit mass of a compound, usually one gram-molecule. It indicates the difference between the energy of a compound and that of its constituent elements.

**Formolite.** The solid product obtained by treating with sulphuric acid and formaldehyde those mineral oils which contain unsaturated cyclic hydrocarbons. The process is known as the formolite reaction and the weight of air-dry formolite obtained from 100 grams of oil is known as the formolite number of the oil. The reaction is also called the "formalin" reaction.

**Formolite Number.** See formolite.

**Formula.** 1. A statement in chemical symbols of the composition of a substance. 2. A recipe for the preparation of some mixture or compound. 3. A mathematical statement of a law.

**Formula, Constitutional.** (Structural or systematic formula.) A formula which shows the molecular structure (or constitution) of a substance in two dimensions, e.g.



is a constitutional formula for benzene.

**Formula, Empiric.** (Rational formula.) A formula which indicates the kind of elements which compose a compound and their simplest relative

proportions. General formulas for homologous series are of this type.

**Formula, Empiric Molecular.** A formula for a compound which indicates the number and kind of its constituent elements.

**Formula, Graphic.** A constitutional formula.

**Formula, Molecular.** A formula which indicates the molecular composition of a substance.

**Formula, Rational.** An empiric formula.

**Formula Rearrangements.** Changes in structural relationships within the molecule which result in formation of new compounds. See Intramolecular change, and isomerism, dynamic.

**Formula, Structural.** A constitutional formula.

**Formula, Systematic.** A constitutional formula.

**Formula Weight.** A term proposed to supersede "molecular weight" when the actual molecular weight of a compound has not been determined. It is calculated from the sum of the atomic weights just as a molecular weight is.

**Formyl.** A univalent acyl radical,  $\text{H.C : O—}$  derived from formic acid. Formylurea,  $\text{NH}_2\text{C : O.NH.CHO}$ .

**Fortified Wines.** Wines, such as sherry and port, to which ethyl alcohol is added after fermentation has been completed in order to increase their alcoholic content.

**Fractional Combustion.** See combustion, fractional.

**Fractional Crystallization.** See crystallization, fractional.

**Fractional Distillation.** See distillation, fractional.

**Fraunhofer Lines.** A series of dark lines which cross the solar spectrum and whose location is fixed. They are designated by letters, occur in great numbers, and afford an accurate means of defining colored light.

**Free.** 1. Uncombined, as a free element. 2. Active, as a free charge. 3. Isolated, as free carbon dioxide.

**Free Charge.** A charge of static electricity on a body.

**Freedom, Degrees of.** The number of variables which must be fixed before the state of a system may be defined according to the phase rule. The relationship between the number of degrees of freedom ( $F$ ), the components ( $C$ ), and the phases ( $P$ ) of a system is expressed by the formula,

$$F = C + 2 - P.$$

Thus a gas has two degrees of freedom. At any temperature its volume and pressure are variable, but if one of these is fixed then the other is automatically determined for, at any given temperature and pressure, each gas assumes one, and only one, volume at equilibrium.

**Free Energy.** That portion of the total energy of a system which can be utilized for doing work.

**Frequency.** The number of vibrations made by a particle or a ray in one second. In electrical engineering frequency refers to the number of alterations in the direction of a current in one second.

**Freeze.** To solidify, especially at low temperatures.

**Freezing Point.** The temperature at which a liquid becomes solid. This is not always identical with the melting point of the solid for many mixtures, particularly of fats and waxes, do not solidify until they have been cooled



several degrees below their melting points. If a liquid be cooled under pressure the freezing point rises if the solid is of higher specific gravity than the liquid; if it is of lower specific gravity, as in the case of water, the freezing point is lowered.

**Freezing Point, Depression of.** The freezing point of a solution is, in general, always lower than that of the pure solvent and the depression is proportional to the active mass of the solute. Abnormal depressions are due to ionization, association, and, sometimes, chemical action. Cf. law of Blagden.

**Friction.** The resistance offered to the motion of one body upon or through another.

**Friction, Internal.** Viscosity.

**Friedel-Craft's Reaction.** See reaction, Friedel-Craft's.

**Frigorific.** An agent which produces cold.

**Fructoside.** A compound of the class of glucosides which, on hydrolysis, yields fructose, e.g. methyl fructoside.

**Fumaroid Form.** The axial symmetric or trans form of ethylene geometrical isomers, named from fumaric acid,



See isomerism, geometrical.

**Function.** A mathematical quantity or quality so related to another quantity that an alteration in one is accompanied by an alteration in the other. The circumference of a circle is a function of the diameter.

**Function, Carnot's.** (Carnotic function.) A relation between the amount of heat lost by a body and the work which can be done by it. See entropy.

**Fuse.** To melt.

**Fusible Metals.** Alloys of low melting point, usually containing bismuth. Ex. Wood's metal, which has the composition, Sn, 1; Pb, 1; Cd, 1; Bi, 4; and melts at 60.5° C.

**Fusiform.** (bot.) Spindle shaped.

**Fusion.** The process of converting a solid into a liquid by raising its temperature.

**Fusion, Watery.** The melting of an hydrated substance below 100° with consequent solution in its own water of crystallization.

**Fusion, Heat of.** (Latent heat of.) The heat absorbed when one gram of solid is converted into liquid without temperature change. The normal heat of fusion is measured at the melting point of the solid under atmospheric pressure.

Ice to water,	80.02 cal.
Benzene,	30.85
Lead,	5.86.

## G.

**Gadolinium.** Metallic element. Gd. At. Wt. 157.3. S. G. 1.31. Valence, 3. Oxide,  $Gd_2O_3$ . Occurs in samarskite.

**Galactometer.** An hydrometer graduated to read in percent of cream, used in testing the quality of milk. A lactometer.

**Galenical.** A liquid mixture of medicinal substances compounded according to the art of pharmacy and used in the treatment of disease.

**Gallium.** Metallic element. Ga. At. Wt. 70.1 S. G. 5.95. S. heat 0.079. M. P.  $30.15^\circ$  C. The eka-aluminium of Mendelejeff. Valence 2 and 3. Oxide  $Ga_2O_3$ . Its sulphate forms a true alum with ammonium sulphate. Occurs in zinc blende.

**Gallon.** (Cong.) A unit of liquid measure. The United States gallon is of 231 cubic inches volume. The imperial gallon used in England contains 277.46 cubic inches and is equivalent to 1.20032 U. S. gallons. The U. S. gallon of water weighs 8.345 pounds at  $4^\circ$  C. and is divided into four quarts, 8 pints, or 128 fluidounces.

1 U. S. gallon = 3.78543 litres.

1 imperial " = 4.54345 "

**Galvanic.** (Voltaic.) Electricity produced by chemical action in cells.

**Galvanometer.** An electrical instrument used for detecting or measuring the strength of an electric current by observing the deflection of a magnetic needle produced by the passage of the current. In the astatic galvanometer two needles, of almost equal magnetic

moment, are suspended on the same axis and the direction of the poles of one is opposite that of the other. The tangent and sine galvanometers in which the strength of the current is proportional to the tangent or sine respectively of the angle of deflection are used in measuring and comparing currents.

**Galvanometry.** The art and process of detecting and measuring the strength of electric currents.

**Galvanoscope.** A sensitive galvanometer.

**Gas.** A fluid characterized by the property of occupying the total volume of any vessel into which it is introduced. Gases vary widely in physical and chemical properties. They are all miscible with each other providing they do not combine. (See, gas law under "law," Ions, gas; and below.)

**Gas, Air.** An illuminating and fuel gas made by blowing air through layers of volatile petroleum distillates.

**Gas Analysis.** See under analysis.

**Gas Balance.** An apparatus for determining the specific gravity of a mixture of gases used in approximately determining the completeness of combustion in a heating plant. It consists of a sensitive balance one arm of which holds a closed glass vessel with a pan and weights, the other holds another glass vessel open at the bottom into which cleaned and dried gases from the chimney are continuously aspirated. The pointer moves over a graduated scale which reads directly in percent of carbon dioxide.

**Gas Battery.** (Gas cell.) A concentration cell in which the electrodes are virtually gaseous.

**Gas Constant.** See constant.

**Gases, Dissociation of.** See dissociation.

**Gases, Bunsen Coefficient of.** See Bunsen coefficient.

**Gases, Expansion of.** See laws of Boyle and Charles.

**Gases, Permanent.** A term applied to gases which were formerly considered non-liquefiable. The distinction has vanished since all the gases have been liquefied.

**Gases, Specific Heat of.** See specific heat.

**Gas Generator.** An apparatus in which a reaction may be carried out to produce a gaseous substance, usually equipped with some device for controlling the rate of evolution of gas, e.g. Kipp's generator; Ostwald's generator.

**Gas, Ideal.** A gas which will obey the gas laws at all temperatures and pressures. Ideal gases are purely hypothetical, no instance of ideal behavior in a gas being known.

**Gas Liquor.** See gas water.

**Gas, Olefiant.** Ethylene,  $\text{CH}_2 = \text{CH}_2$ . So called from its formation of an oil on combining with chlorine. From this the "olefin" series of hydrocarbons derives its name.

**Gasometer.** An apparatus for holding and measuring large quantities of gas.

**Gasometric.** Pertaining to the measurement of gases, e.g. the methods of gas analysis.

**Gas Tar.** Coal tar, the tarry matter produced in the distillation of bituminous coal.

**Gas Washer.** A scrubber or other apparatus in which coal gas is brought into contact with water so that ammonia and other water soluble matters are removed.

**Gas Water.** The mixed ammoniacal liquors from the hydraulic main and the scrubbers produced in the manufacture of coal gas.

**Gauge.** An instrument used to measure a quantity, to determine the state of a phenomenon, or the numerical quality of a system at any given time, as a pressure gauge, or a rain gauge.

**Gauss.** The unit of intensity of a magnetic field.

**Gay-Lussac Tower.** A tower used in the chamber process for sulphuric acid. It is built very much like the Glover tower but is commonly twice as high. Two towers are sometimes used. Its function is to remove oxides of nitrogen from the waste gases of the process. To accomplish this concentrated sulphuric acid is allowed to flow down through the filling of the tower while the gases enter at the bottom, pass upward and escape at the top. The oxides of nitrogen are absorbed by the acid which is collected at the bottom of the tower and pumped to the Glover tower.

**Gel.** 1. A jelly. 2. A solid gelatinous form in which a colloidal system is sometimes obtained as distinguished from the liquid form, or "sol." Sols and gels are mutually transformable. The terms hydrogel and alcogel have been applied to gels in which one of the components is water or alcohol respectively. Graham used the terms pektise and pektization for gelate and gelation.

**Gelate.** To form a gel, especially when a sol solidifies.

**Gelation.** The process of forming a gel. Pectization.

**Gelatigenous.** Producing gelatin, as certain animal tissues do.

**General Formulas.** See under formula.

**Generality.** } A conception or  
**Generalization.** } principle which applies to a large number of facts. A universal law.

**Generator.** An apparatus for the preparation of a gas or vapor by chemical action. See gas generator.

**Generic.** Comprehensive. Pertaining to a class or genus. Not specific.

**Geneva Nomenclature.** The accepted international system of nomenclature for carbon compounds. See carbon compounds, nomenclature of.

**Geo-Coronium.** A gaseous element assumed, through spectral evidence, to exist in the highest layers of the atmosphere.

**Geometrical Isomerism.** See isomerism, geometrical.

**Geotaxis.** } The influence of grav-  
**Geotropism.** } ity upon the growth of animal or plant structures. Organs which grow toward the center of the earth are positively geotropic; those which grow away from it, negatively geotropic.

**Germanic.** Salts of germanium in which the metal is quadrivalent.

**Germanium.** A metallic element. Ge. At. Wt. 72.5. S. G. 5.469. S. heat 0.0737. M. P. 900° C. Valence 2 and 4. Oxides  $\text{GeO}$  and  $\text{GeO}_2$ . Germanium chloroform,  $\text{Ge.HCl}_3$ . B. P. 75° C.

**Germanous.** Salts of germanium in which the metal is bivalent.

**Gill.** A unit of liquid measure equal to the fourth part of a pint.

1 gill = 4 fluidounces.

1 " = 7.219 cu. in.

**Glabrous.** Smooth. Not hairy or rough.

**Glacial.** Solid. Used to distinguish certain chemical compounds from their liquid analogues, as glacial acetic acid, or glacial phosphoric acid (metaphosphoric acid).

**Glaidins.** See proteins.

**Glass.** A solid solution of a mixture of silicates, an alkali silicate always being present. Transparent glass usually contains potassium or sodium, and lead or calcium silicates. Other metals are added to furnish special qualities as color, hardness, low coefficient of expansion, insolubility, etc.

**Glaucous.** (bot.) Covered with a white bloom.

**Glaze.** A smooth glass-like coating applied to ceramic ware. Salt glaze is a double silicate of sodium and aluminium produced during the firing of earthenware by throwing common salt into the kiln. Transparent glazes are made of various glasses. Enamels are suspensions of metallic oxides and other substances in a transparent glaze. Porcelain glaze is a mixture of feldspar, quartz, and lime, and is fused into the body of the ware.

**Globulins.** See proteins.

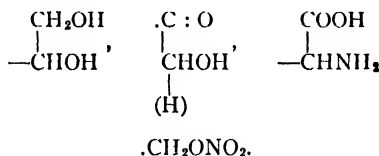
**Glomerate.** (bot.) Compactly clustered.

**Glover's Tower.** A tower, ten feet across and some thirty feet high, of sheet lead, lined with acid resisting material and filled with lumps of quartz or similar substance, used in

the chamber process for the manufacture of sulphuric acid. The gases from the pyrites or sulphur burners enter at the bottom, pass up through and are conducted from the top to the first lead chamber. Meanwhile a mixture of acid from the Gay-Lussac tower and of dilute acid from the chambers is allowed to drip through, whereby it is freed from oxides of nitrogen, much water, and the gases are cooled to 50–60° C. Some sulphuric acid is formed from the gases in the tower.

**Glucinum.** (Beryllium.) Metallic element. Gl (Be). At. Wt. 9.1. S. G. 1.85. Valence 2. Oxide  $\text{GlO}$ . Occurs in beryl and the emerald.

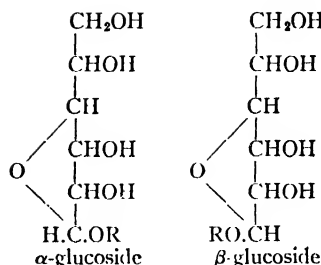
**Gluciphores.** A group of atoms which has the power to form sweet compounds by uniting with a number of otherwise tasteless atoms or radicals. (Oertly and Myers.) Examples of gluciphores are



The radicals with which gluciphores combine are termed "auxoglucs."

**Glucosanes.** The polysaccharoses which yield hexoses on hydrolysis, to distinguish them from the pentosanes.

**Glucoside.** (Glycoside.) An etheral compound of a carbohydrate formed by the union of a sugar with a non-sugar, water being eliminated. The term is used to include the whole class and is also applied to the subclass which yields glucose on hydrolysis. Glucosides are classified in several ways; as  $\alpha$  and  $\beta$  according to the constitution of the molecule:

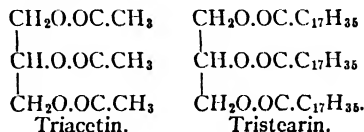


Emulsin hydrolyzes the  $\beta$ -glucosides only and the  $\alpha$ -glucosides only are hydrolyzed by maltase. Glucosides are further classified according to the sugar formed during their hydrolysis as (true) glucosides, fructosides, rhamnosides, galactosides, mannosides, arabinosides, xylosides, sorbosides, glucoheptosides, etc., or as aldoses or ketoses if formed from aldoses or ketoses. Other classifications are based upon the nature of the non-sugar or "aglycone" group formed when glucosides are hydrolyzed. Glucosides may also be classed as disaccharoses.

**Glucosides, Cyanogenetic.** Glucosides which yield hydrocyanic acid among their hydrolytic products, e.g. amygdalin, on hydrolysis yields dextrose, benzaldehyde, and  $\text{HCN}$ . A large number of cyanogenetic glucosides is known.

**Glutelins.** See proteins.

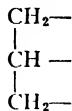
**Glycerides.** Organic esters in which the alcohol radical is glyceryl derived from glycerin. Thus,



The natural fats are glycerides. Mixed glycerides contain two or three different acid residues in the same molecule.

**Glycerol.** (Glycerin.) The simplest trihydric alcohol,  $C_3H_8(OH)_3$ .

**Glyceryl.** The trivalent radical



found in natural fats, lecithin, etc.  
Derived from glycerin.

**Glycols.** Dihydric alcohols, so called from glycol,



the simplest member of the class. Glycols are named according to the Geneva convention by adding the suffix "diol" to the stem of the parent hydrocarbon, e.g. glycol is *ethandiol*. Glycols are distinguished as  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , etc., according to the relative positions of the hydroxyl groups (1 : 2, 1 : 3, 1 : 4, etc.) in the carbon chain and as diprimary, primary-secondary, primary-tertiary, dissecondary, secondary-tertiary, ditertiary, according to the nature of the alcohol groups. Compounds in which two hydroxyls are attached to the same carbon atom are not regarded as glycols.

**Glycoproteins.** See proteins.

**Glycoside.** See glucoside.

**Gold.** (Aurum.) Au. At. Wt. 197.2. S. G. 19.32. S. heat, 0.0316. M. P. 1060° C. B. P. 2530° C. Valence 1 and 3. Oxides,  $Au_2O$ ,  $Au_2O_3$ . Forms two series of salts. Occurs native and in combination.

**Goniometer.** An instrument used in measuring angles, especially the angles of crystals.

**Goniometric.** Pertaining to the measurement of angles with a goniometer.

**Graduate.** A vessel calibrated either in fluidounces or millilitres or both, of a conical shape, and used to measure liquids.

**Grain.** (gr.) A unit of weight in the English system equal to the 480th part of an apothecaries' ounce.

1 grain = 64.8 mgm.

437.5 grains = 1 avoirdupois ounce.

15.4324 grains = 1 gram.

**Gram.** A unit of weight in the metric system. It is the thousandth part of the international kilogram and is very nearly the weight of one cubic centimeter of distilled water at 4° C.

1 gram = 15.4324 grains.

28.3495 grams = 1 av. ounce.

31.10348 " = 1 troy ounce.

453.59 " = 1 av. pound.

1 gram = 1,000 milligrams.

1,000 grams = 1 kilogram

= 2.2 pounds.

**Gram-Equivalent.** The atomic weight of an element (or formula weight of a radical) divided by its valence. In the case of multivalent substances there will be more than one value for the gram-equivalent, viz.,  $Fe^{++} = 27.92$ ,  $Fe^{+++} = 18.61$ .

**Grammole.** A mol or gram-molecule.

**Graphic Formula.** See formula, constitutional.

**Gravity.** (Gravitation.) The attraction which exists between all material bodies anywhere in the universe. Specifically, the attraction of the earth for bodies near its surface. The attraction between the earth and a mass of one gram is 980 dynes. The force of the attraction is measured from the center of the two bodies, is proportional to the product of their mass ( $m_1$ ,  $m_2$ ) divided by the square of the distance between them ( $d$ ), or,

$$F = G(m_1m_2/d^2),$$

where  $G$  is the Newtonian constant, 980 dynes.

**Gravimetric Analysis.** See analysis, quantitative.

**Green-Oil.** (Anthracene oil.) One of the fractions obtained in the distillation of coal tar. It contains about ten percent of anthracene with higher hydrocarbons, phenanthrene, chrysene, paraffin, etc.

**Grotthus Theory.** A theory to explain electrolysis which postulated that when an electric current passes through a system, e.g. water, the molecules arrange themselves so that the atoms face the electrode to which they are attracted; the extreme molecules now give up to the electrodes the attracted atoms and the repelled atoms immediately combine with the next nearest molecules a rearrangement or "shifting of partners" taking place throughout the solution. Another atom is given up to the electrode and the process is repeated. This theory has been superseded by the ionic hypothesis of conductivity.

**Group Properties.** Properties common to groups of substances, i.e. colligative properties, the property of ionizing, etc.

**Groups, Atomic.** 1. Radicals. 2. Certain arrangements of atoms which confer specific properties upon the compounds in which they occur, as the amine ( $\text{NH}_2$ ), carboxylic ( $\text{COOH}$ ), carbonyl ( $\text{C}:\text{O}$ ) groups, etc. See under atomic.

**Gum Resin.** A resinous substance which contains gum as well as resin. Several of them, asafoetida, gamboge, and galbanum are important pharmaceutically.

**Gums.** A class of amorphous transparent substances allied to the carbohydrates characterized by insolubility in alcohol and organic solvents. The "real gums" dissolve in water, the vegetable mucilages (which belong to the class of gums) swell up in that solvent to form sticky masses. On oxidation with nitric acid all gums yield mucic and oxalic acids. Gum arabic, gum tragacanth, cherry gum, and plum gum, are examples of this class.

## H.

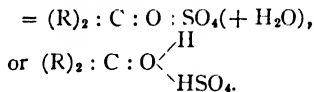
**Haemolysins.** (Hemolysins.) Metabolic products of bacteria, some plants, snakes, toads, bees, spiders etc., which have the power of producing haemolysis. Certain of these exist normally in blood serum or are produced during immunization.

**Haemolysis.** (Hemolysis. Laking.) The separation of hemoglobin from the stroma of the blood and its appearance in the serum. This is effected by hypotonic solutions, a number of chemical compounds (ether, chloroform, alkalies, biliary acids, and especially saponins) and by haemolysins.

**Half-Rotation.** See mutarotation.

**Halides.** Salts of the hydrohalogen acids; the fluorides, chlorides, bromides, and iodides. Halogenides. Cf. Alkyl halides.

**Halochromism.** The phenomenon of color-development from colorless carbonyl compounds when they are dissolved in mineral acids. It is thought to be due to the formation of an oxonium salt, e.g.  
(R)<sub>2</sub> : C : O + H<sub>2</sub>SO<sub>4</sub>



**Halochromy.** The property of forming colored salts by halochromism.

**Halogens.** A family of elements including fluorine, chlorine, bromine, and iodine.

**Halogen Esters.** The alkylogens or alkyl haloids.

**Halogenides.** 1. Halides. 2. Halogen substitution products of organic compounds.

**Halogenous.** (Haloid.) Pertaining to or containing a halogen.

**Halohydrines.** The primary haloid esters of the glycols, e.g. glycol chlorohydrine, CH<sub>2</sub>Cl.CH<sub>2</sub>OH.

**Haloid.** Halogenous (q.v.).

**Haptophore.** Molecules and groups which combine the toxophores (of bacterial toxins) with similar groups in the tissue cells of the affected organism.

**Hard Water.** A condition of water due to the presence of calcium salts with usual accompaniment of magnesium salts, termed hardness. If the compounds present are carbonates held in solution by carbon dioxide the water may be freed from hardness by boiling which drives off the carbon dioxide and precipitates the carbonates. Such water is termed "temporary hard water" and the condition is known as temporary hardness. When calcium sulphate and other soluble salts of calcium and magnesium are present boiling will not "soften" the water and it is referred to as "permanent hard water" the condition being called permanent hardness. Alkaline carbonates, zeolite, etc., are used to "soften" permanent hard water. Generally a sample of water possesses both kinds of hardness.

**Hardness.** See hard water.

**Hardness, Degree of.** An index of the amount of alkaline earth metal,



calculated as calcium carbonate, present in a sample of water. Clark's scale used a degree based on one grain of calcium carbonate per imperial gallon. The French scale used a degree corresponding to one part of the same in 100,000 of water. The German degree corresponded to one part of calcium oxide per 100,000 of water. These scales have been discarded in favor of the more uniform method of reporting the hardness as so many parts of calcium carbonate per million of water.

**Häser's Coefficient.** A number, 2.33 used to approximate the total solids in a sample of urine from the specific gravity. The second and third decimal figures in the S. G. are multiplied by the coefficient and the product used as *W* in the formula,  $\text{grams} = W \times \text{Vol}/1000$ . Long uses the coefficient 2.6 at 25°.

**Heat, Atomic.** The product of the atomic weight of an element and its specific heat. The figure is nearly constant for most elements. See law of Dulong and Petit.

**Heat Index.** (Heat number.) Essentially the same as "Maumené number." Determined by mixing 20 mils of oil with 5 mils of sulphuric acid and noting the temperature rise.

**Heating Value of Fuels, Formulas.** The calorific value of fuels may be approximated from the analysis. If C, H, N, and O represent the percent of carbon, hydrogen, nitrogen, and oxygen,

$$Q = \frac{8,000 C + 34,500 (H - 1/8.0)}{100} \quad \text{(Dulong's formula).}$$

$$Q = \frac{8,140 C + 34,500 H - 3,000(O+N)}{100} \quad \text{(Mahler's formula).}$$

**Heat, Molar.** } The product of  
**Heat, Molecular.** } the molecular weight of a compound and its specific heat.

**Heat Number.** See heat index.

**Heat Summation, Law of.** See law of heat summation.

**Hectare.** A measure of area in the metric system equal to 100 square meters.

$$1 \text{ acre} = 0.4047 \text{ hectare.}$$

$$2.471 \text{ acres} = 1.00 \quad "$$

**Hectogram.** A mass of one hundred grams.

**Hectometer.** A length or distance of one hundred meters equal to 304.8 feet.

**Hehner Number.** The percent of water insoluble fatty acids obtainable from a fat. This constant is lower for butter than for most fats and is of value in testing its purity. (A Hehner solution is used in determining the iodine number of oils.)

**Helide.** A "compound" of helium and some other element. It is alleged that the radioactive elements are helides since they continuously give off helium and the idea is extended to include all the elements. It is stated that very probably nitrogen is a complex of three helium atoms and two hydrogen atoms.

**Heliotaxis.** } The phenomenon of  
**Heliotropism.** } a plant, flower, or leaf turning or growing toward the sun. Such structures are termed heliotropic. Cf. Chemotaxis and geotropism.

**Helium.** Gaseous element. He. At. Wt. 4.00 S. G. 1.98 ( $H = 1$ ). M. P.  $-270^\circ$ . B. P.  $-268.7^\circ$ . Forms no known compounds in the ordinary sense (cf. helide). 1,000 vols of air

contain 0.0014 vol. Formed in the degradation of radium.

**Hemicelluloses.** Cell-wall constituents related to cellulose. They dissolve when heated with very dilute mineral acids and yield, on hydrolysis, arabinose, xylose, galactose, and mannose.

**Hemihedrity.** A crystal phenomenon. Sometimes only half of the identical parts are modified at the same time and in the same manner. Thus a cube ought to be truncated at the same time on its eight solid angles, but in certain cases it is only truncated in four, as in boracite. (Pasteur.) Such forms are termed hemihedral.

**Hemipeptone.** A product of the tryptic digestion of protein as distinguished from "antipeptone." On further digestion it yields amino acids and other products while antipeptone is not attacked.

**Hemiterpenes.** A class of terpenes of the formula  $C_5H_8$ , e.g. isoprene.

**Hemitrope.** A twin crystal.

**Hemoglobins.** (Chromoproteins.) See proteins.

**Hemolysins.** See haemolysins.

**Hemolysis.** See haemolysis.

**Henry.** The unit of inductance and self-inductance, defined as the inductance in a circuit in which the induced E.M.F. is one volt when the inducing current changes at the rate of one ampere per second.

1 henry =  $10^9$  c.g.s. units.

**Henry's Law.** See law of Henry.

**Hepatic Gas.** Hydrogen sulphide. (Obs.)

**Hepatization.** (To hepatize.) Impregnation with hydrogen sulphide.

**Herb.** A plant which does not form a permanent, woody stem.

**Hermetic Art.** Alchemy.

**Hessian Crucibles.** Crucibles made of sand.

**Hetero-Atoms.** Members of a ring-shaped nucleus other than carbon atoms; as in pyridine, the nitrogen atom, and in thiophene, the sulphur atom, are hetero-atoms.

**Heterocarpus.** (bot.) Producing more than one kind of fruit.

**Heterocyclic.** Containing hetero-atoms, as certain rings or cyclic compounds.

**Heterogamous.** (bot.) Bearing two kinds of flowers.

**Heterogeneous.** Consisting of more than one molecular species or more than one phase. See equilibrium, reaction, catalysis.

**Heterology.** Relationship between substances of partial identity of structure but of different properties, as benzol, phenol, benzoic acid, aniline. Cf. homology, isology.

**Heteronuclear.** A condition in which two (or more) substituents occur in different rings or nuclei of compounds which contain two or more rings, as naphthalene, quinoline, anthracene, etc. When the substituents are both located in the same ring the condition is termed isonuclear.

**Hexad.** An element which has a valence of six, as chromium in the chromates, and sulphur.

**Hexon Bases.** The diamino acids lysine, arginine, and histidine which contain six carbon atoms.

**Hexoses.** Carbohydrates derived from a six-carbon chain, as dextrose and fructose. They are divided into

aldohexoses and ketohexoses according to whether they exhibit the properties of aldehydes or ketones.

**Hirsute.** (bot.) Hairy, especially when the hairs are coarse and stiff.

**Histolysis.** Hydrolysis of hippuric acid by the enzyme histozyme which occurs in some animals.

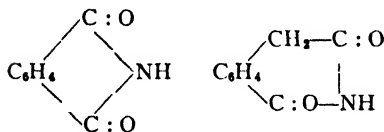
**Histones.** A class of proteins related to the protamines and characterized by being precipitated from solution by ammonia. See proteins.

**Hittorf Number.** (Transport number.) The share of the current conducted by an ion in electrolysis.

**Holmic.** A compound of holmium.

**Holmium.** Metallic element. Ho. At. Wt. 163.5. Occurs in gadolinite.

**Homo-.** A prefix which denotes that a compound contains one  $\text{CH}_2$  group more than the compound which furnishes the root of the name, as



Phthalimide. Homo-phthalimide.

Such compounds are homologous. The correlative prefix is "nor-."

**Homochromoisomerism.** The phenomenon in which different structural modifications of organic compounds exhibit the same color and identical absorption bands in solution.

**Homocyclic.** A ring or nucleus all of whose members are atoms of the same element, e.g. the benzene ring. Cf. heterocyclic.

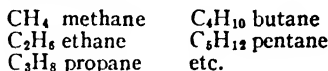
**Homoeomorphism.** (Adj. homoeomorphous.) A term suggested by Ostwald as a substitute for isomorphism

since the agreement of the crystal angles of isomorphous substances is often not perfect.

**Homogamous.** (bot.) Bearing but one kind of flower.

**Homologous.** A member of the same homologous series.

**Homologous Series.** A series of carbon compounds of the same type which conform to a general formula and in which each member differs from the preceding member by a constant increment of the atomic group  $\text{CH}_2$ . Ex. in the paraffin series we have the general formula  $\text{C}_n\text{H}_{2n+2}$ , and the compounds



The phenomenon is known as homology, the compounds are homologous and any one of them is the homologue of any other in the series. Cf. Homo-, isology.

**Homologue.** A member of an homologous series.

**Homology.** The phenomenon exhibited by an homologous series, q.v.

**Hormones.** 1. Substances produced normally by certain living cells and which stimulate or provoke some functional activity in the organism, as suprarenin, the thyroid hormone, etc. 2. Solvents which make plasmatic membranes permeable to certain reagents and stimulate or render active the cell enzymes.

**Horse-Power, French.** (Cheval-vapeur.) A unit of power defined as the power required to raise 75 kilograms through one meter in one second.

**Horse-Power.** (H.P.) A unit of power in the English system defined as the power to do 33,000 foot pounds of work per minute or 550 per second.

1 kilowatt = 1.34 H.P.

1 H.P. = 746 watts.

**Horse-Power, Metric.** (P.S.)

1 P.S. = 736 watts.

1 H.P. = 1.014 metric H.P.

**Hübl Number.** The iodine number of a fat or oil.

**Hybrid.** (bot.) A plant produced by cross breeding two species.

**Hydr-.** A prefix which indicates a content of hydrogen, as in hydrazine.

**Hydracids.** Acids which contain no oxygen, as hydrochloric, or hydrobromic. (Obs.)

**Hydrargyric.** A compound of mercury in which the metal is divalent.

**Hydrargyrum.** The Latin name for the metal mercury, whence the symbol Hg is derived.

**Hydramines.** (Oxyalkylamines.) A series of amines derived from the glycols in which one hydroxyl is replaced by an amino group, e.g. oxyethylamine,  $\text{CH}_2\text{OH}.\text{CH}_2\text{NH}_2$ .

**Hydrate.** 1. A compound which contains combined water as water of crystallization, or as in those hydroxides which may be converted into the corresponding oxides by heat ( $\text{CaO}_2\text{H}_2$ ,  $\text{AlO}_3\text{H}_3$ ). 2. A substance which is not anhydrous.

**Hydrated.** 1. Not anhydrous. 2. Moist, used in cases where even the feeblest chemical combination cannot be observed as in certain moist gases, hydrated chalk, etc. 3. Combined with water to form a hydrate.

**Hydrate Theory.** A theory of solutions which assumes the formation of definite hydrates between solvent and solute, which, in some cases, vary according to the concentration.

**Hydration, Heat of.** 1. The energy difference between an anhydrous com-

pound and its crystalline form where it crystallizes with combined water. 2. The work done when a colloid swells in water.

**Hydration, Water of.** Water of crystallization.

**Hydrazo Compounds.** Compounds of the general type  $\text{R}-\text{NH}-\text{NH}-\text{R}'$ , in which R and R' may be identical or different organic radicals. Produced by the reduction of the azo compounds.

**Hydrazocarbyls.** Löwig's term for amino acids.

**Hydrazone.** The first product of the reaction between certain sugars and one mol of phenylhydrazine acetate which is a simple addition of the phenylhydrazine molecule with elimination of water. With excess of phenylhydrazine osazones (q.v.) are formed.

**Hydric.** Pertaining to or containing hydrogen.

**Hydrils.** Obsolete term for alkaloïds and metalorganic compounds.

**Hydride.** A compound of hydrogen with any other element, particularly a metal, as arsine ( $\text{AsH}_3$ , arsenic hydride), stibine ( $\text{SbH}_3$ , antimony hydride), or phosphine ( $\text{PH}_3$ , phosphorous hydride).

**Hydriion.** A name applied to the hydrogen ion, i.e. the positively charged hydrogen atom.

**Hydro-.** A prefix indicating content of hydrogen or pertinence to water as hydrocarbon, hydrochloric, hydrodynamics, hydrolytic.

**Hydrocarbon.** (Carbonhydride.) Any compound which contains carbon and hydrogen only. These are regarded as the parent substances in organic chemistry from which all other organic compounds may be

considered derived. They are classed as saturated, unsaturated, aliphatic, carbocyclic, or limit hydrocarbons. For nomenclature see carbon compounds, nomenclature of.

**Hydrocarbons, Limit.** Saturated hydrocarbons of the paraffin series so called because they contain the limit of hydrogen.

**Hydrocarblys.** Obsolete term for the parent hydrocarbons.

**Hydrocellulose.** A substance of the formula  $C_{12}H_{22}O_{11}$  produced by the prolonged action of dilute sulphuric acid or of aluminic chloride and magnesium chloride (at  $300^{\circ} F.$ ) on pure cellulose.

**Hydrochloric Acid.** The simplest acid compound of chlorine.  $HCl$ . Its salts are termed chlorides.

**Hydro-Diffusion.** Diffusion in aqueous media.

**Hydrogen.** Non-metallic gaseous element. H. At. Wt. 1.008. Mol. Wt. 2.016. Spec. Heat 3.410. Valence 1. Combines with all elements except the five noble gases. M. P.  $-256.5^{\circ}$ . B. P.  $-252.5^{\circ}$ . 1 liter of hydrogen under standard conditions weighs 0.08987 gram. One gram of hydrogen at S.T.P. occupies 11.117 liters.

**Hydrogenate.** (Hydrogenize.) To reduce. To cause to combine with hydrogen, as to hydrogenate oils which contain fats derived from unsaturated acids (oleic) in which case the unsaturated acids are converted into saturated "fatty" acids.

**Hydrogenide.** A hydride.

**Hydrogen Ion Concentration.** The concentration of ionic hydrogen in any system, especially as denoted by the symbol  $P_H$  (or  $pH$ ) in the notation introduced by Sørensen.  $P_H$  is

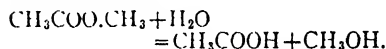
the logarithm of the reciprocal of the hydrogen ion concentration expressed in grams per liter, or (to avoid reciprocals) the logarithm of the volume. Thus, the  $P_H$  of neutral water has been shown to be 7, since water contains 0.000,000,1 gram hydrogen ions per liter or  $10^{-7}$ .

**Hydrogen Ion, Normal Solution.** A solution which contains one gram equivalent of hydrogen ion. Used as a basis in computing  $P_H$ .

**Hydrogenium.** Latinized form of hydrogen.

**Hydrogenize.** To hydrogenate.

**Hydrolysis.** Literally water-splitting. A process of decomposition in which the products of the reaction take up the elements of water in the sense that one product assumes an hydrogen atom and the other an hydroxyl group derived from water in the system. E.g. methyl acetate on hydrolysis yields methyl alcohol and acetic acid, viz.,



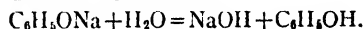
Saponification is a special case of hydrolysis. The adjective hydrolytic is used to denote the process of hydrolytic and the agents which catalyze it.

**Hydrolysis, Reversible.** Hydro-synthesis.

**Hydrolysis, Zymo.** See zymohydrolysis.

**Hydrolytic.** See hydrolysis.

**Hydrolytic Dissociation.** The hydrolysis of a salt upon solution in water, e.g. sodium phenolate,



2. Ionization upon solution in water.

**Hydrolytic Ferment.** See enzymes.

**Hydrometer.** An instrument used for determining the specific gravity of a liquid, depending upon the principle that the volume of a floating body immersed in a liquid is inversely proportional to the density of the liquid. Hydrometers are commonly graduated to read directly in specific gravity, but forms are made for special purposes which are graduated differently. "Alcoholometers" are graduated to read directly in percent of absolute alcohol or of proof spirit. See below.

**Hydrometer Scales.** 1. Baumé scale, for liquids lighter than water, Degrees Baumé

$$= \frac{140}{\text{S.G.}} (60^\circ/60^\circ) - 130.$$

2. Baumé-Beck scale, for liquids heavier than water,  $0^\circ = 1.0000$  S.G.,  $10^\circ = 1.0731$ ,  $20^\circ = 1.1578$ ,  $30^\circ = 1.2569$ ,  $50^\circ = 1.5167$ .

3. Twaddle scale,

$$(\text{Degrees Twaddle} \times 5) \div 1,000 + 1.000 = \text{S.G.}$$

4. Gay-Lussac scale,

$$\text{S.G.} = \frac{50}{\text{Degrees G-L}} \times 2.$$

**Hydrometry.** The process of determining the density or specific gravity of liquids (by means of an hydrometer).

**Hydrosols.** Colloidal systems in which the dispersion medium is water.

**Hydrosulphate.** A sulphide.

**Hydrosulphide.** An acid sulphide, as  $\text{NH}_4\text{SH}$ .

**Hydrosulphuret.** A hydrosulphide.

**Hydrosulphuric Acid.** Hydrogen sulphide.

**Hydrosynthesis.** The correlative of hydrolysis. A condensation reaction in which water is eliminated. See condensation.

**Hydrous.** Containing either admixed or combined water. Not anhydrous.

**Hydroxide.** A compound of a metal derived from water by replacement of one or more hydrogens by an equivalent quantity of element, except that one molecule of water furnishes but one atom of hydrogen, as  $\text{NaOH}$ ,  $\text{CaO}_2\text{H}_2$ ,  $\text{AlO}_3\text{H}_3$ . According to the ionic hypothesis hydroxides, in solution, ionize to form metallic and hydroxyl (OH) ions.

**Hydroxidion.** The hydroxyl group in solution bearing a negative electric charge. The hydroxyl ion. It is characteristic of bases.

**Hydroxy.** A prefix indicating content of the group  $-\text{OH}$ . Sometimes hydroxyl compounds are termed "oxy," as oxymalonic acid,  $\text{CH}(\text{OH})_2(\text{COOH})_2$ , regarded as derived from malonic acid by addition of oxygen rather than by substitution of hydroxyl for hydrogen.

**Hydroxyl Group.** The univalent group  $-\text{OH}$  characteristic of bases, many acids, phenols, and, in combination, of alcohols, carboxylic and sulphonic acids, as well as amphoteric compounds. In combination with metallic radicals it confers strong basic properties upon the resulting compounds; with non-metals like sulphur and phosphorus, it forms strongly acid compounds. In solution, if ionized, the hydroxyl group forms the basic hydroxidion.

**Hyper-** A prefix which indicates "over," "excess," "greater," equivalent to per and super, e.g. hyperoxide.

**Hyperisotonic.** Hypertonic solutions. See isotonic.

**Hyperoxide.** An oxide which contains a very large relative proportion of oxygen. (Obsolescent.)

**Hypertonic Solutions.** See isotonic.

**Hypisotonic Solutions.** Hypotonic solutions. See isotonic.

**Hypnotics.** Drugs which cause sleep.

**Hypo-.** A prefix which indicates that the principal element in the compound is combined in a low or in its lowest state of valence.

**Hypochlorous Acid.** An oxyacid of chlorine,  $\text{HClO}$ .

**Hyponitrous Acid.** A nitrogen acid,  $\text{H}_2\text{N}_2\text{O}_2$ , which may possibly exist in syn and anti forms.

**Hypophosphoric Acid.**  $\text{H}_2\text{PO}_3$ . Its salts are the hypophosphates.

**Hypophosphorous Acid.**  $\text{H}_3\text{PO}_2$ . Its salts are the hypophosphites some of which are used medicinally.

**Hyposulphurous Acid.**  $\text{H}_2\text{S}_2\text{O}_4$ , known only in aqueous solution. Often confused with thiosulphuric acid ( $\text{H}_2\text{-S}_2\text{O}_3$ ) whose sodium salt is improperly termed sodium hyposulphite.

**Hypothesis.** A purely ideal supposition which may be true or untrue.

As used in chemistry it appears to be confirmed by facts but is not as certain as a true theory. Cf. laws.

**Hypothesis, Atomic.** The atomic theory, q.v.

**Hypothesis, Avogadro's.** See Avogadro's hypothesis.

**Hypothesis, Molecular.** The molecular theory, q.v.

**Hypotonic Solutions.** See isotonic.

**Hypsochromic Groups.** (Hypsochromic.) Those groups which, when they are introduced into a compound, cause a displacement of the bands in the absorption spectrum toward the violet end. Among these groups are the nitro and amido groups and hydrogen. The greater the molecular weight of the substituent, the greater the displacement. Cf. Bathochromic.

**Hysteresis.** (Passive resistance.) Thermodynamically, a retardation of the movement of a system to a condition of stable equilibrium. Probably responsible for metastable equilibrium.

## I.

**Iamatology.** Materia medica. The study of medicinal substances.

**Iatrochemistry.** Therapeutics based on chemistry. Applied especially to a school of 17th century Flemish physicians who attempted to explain health and disease by chemical principles. They were known as iatrochemists.

**-Ic.** A suffix which, unless modified by a prefix like hydro-, indicates that a compound contains its chief element in the highest state of oxidation and consequently exhibits the highest valence possible in the particular type of combination, e.g. ferric, cupric, chloric. The rule is not without exceptions, for compounds of higher degree of oxidation occur as in the case of chloric ( $-\text{ClO}_3$ ) and perchloric ( $-\text{ClO}_4$ ). In the case of chromium, chromic compounds contain trivalent chromium while in the chromates, the metal is hexavalent. Ic acids form salts named -ates.

**Ice.** 1. Solid water. 2. A solid produced by freezing a liquid.

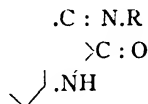
**-Id.** } Suffixes indicating that a  
**-Ide.** } compound has been derived from a non-oxygenated acid, as sulphide, chloride, cyanide, etc. The corresponding acids are characterized by the prefix "hydro" and the suffix "ic," as hydrochloric, hydrocyanic, etc.

**Idiomorphous.** Appearing in distinct crystals.

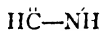
**Ignition Point.** (Kindling point.) The minimum temperature which will enable combustion or explosion to take place. The flash point of gases.

**Ilmenium.** Announced by Hermann as an element; shown to be a mixture of columbium and tantalum.

**Imesatins.** Derivatives of isatin formed by the action of ammonia and primary amines, of the general formula,



**Imidazol Ring.** The complex,  
 $\text{.C—N}$



**Imide.** A compound, derived from an acid, which contains the imido group. (Secondary amines are not imides.)

**Imido Group.** The divalent group : NH.

**-In.** A suffix which indicates a non-basic proximate principle of a plant, a protein, or a carbohydrate, as all of the glucosides (amygdalin, digitalin), vitellin, inulin, caffein. This suffix has been used in naming strong bases such as alkaloids, e.g. morphin, cocain, strychnin, but the suffix *-ine* is the proper termination for such compounds.

**Inactive Compounds.** Optical isomers which do not rotate the plane of polarized light.

**Inactive, Divisible Compounds (or Type).** Substances which do not rotate the plane of polarized light but



which may be separated into equal amounts of dextrorotatory and laevorotatory compounds, e.g. racemic compounds. Such substances are inactive by external compensation.

**Inactive, Indivisible Compounds (or Type).** Compounds which, although they contain asymmetric atoms, do not rotate the plane of polarized light. The effect is supposed to be due to equal and opposite rotations of two asymmetric atoms, e.g. mesotartaric acid. These compounds cannot be separated into optically active isomers and are said to be inactive by internal compensation. See isomerism, optical.

**Inch.** A unit of linear measure in the English system.

1 inch	= 25.4001 mm.
1 "	= 2.54 cm.
0.3937 "	= 1.00 cm.
39.37 inches	= 1. meter.

**Inclination to Reaction.** Tendency to reaction. A condition where a difference in the intensity of the chemical energy of different substances in a system will equalize itself if an opposing influence is withdrawn.

**Incombustible.** Not consumed or decomposed by heat or flame.

**Incompatibility.** In pharmacy a condition which arises when two substances possess properties which cannot be harmonized. Incompatibility is termed chemical, pharmaceutical, or physiological according to whether the compounds react upon each other in an undesirable manner, are immiscible like oil and water or liquefy like mixtures of camphor and menthol, or are physiological antagonists like atropine and pilocarpine or strychnine and chloral hydrate.

**Incompressible Volume.** A portion of the volume of a gas which remains constant under compression, and to which is partly due the deviations from

the gas law. It is denoted by the quantity  $b$  in the van der Wall's equation. See co-volume.

**Inconstant Elements.** Volatile elements.

**Indamines.** Dyestuffs derived from the indoanilines by substitution of  $-NH_2$  for the quinone oxygen. Phenylene blue,  $C_6H_4-N-C_6H_4NH_2$ .



**Indicator.** A substance which exhibits an observable difference in color according to the acidity or alkalinity of its environment and which may be used to determine the reaction of a solution, or whose color changes or disappears with increase or decrease of hydrogen ion concentration in its solution, or which indicates the beginning or end of a reaction by a color change. Common indicators and the colors they exhibit are,

Indicator.	Acid.	Alkaline.
litmus,	red	blue
phenolphthalein,	white	red
iodosin,	pink	white
methyl orange,	red	orange-yellow
turmeric,	yellow	brown.

**Indicators, Chromophoric Theory of.** The hypothesis that the change in color exhibited by indicators is due to intramolecular transitions from quinoid (chromophore) to benzenoid forms and vice versa.

**Indicators, Ionization Theory of.** The hypothesis that the color of an indicator in solution is due to its degree of ionization. In alkaline solutions there will be more negative ions than in neutral solutions and in acid liquids still less of the negative ions. If the color of the negative ion of an indicator differs from that of the molecule (as in the case of methyl-orange) there will be a difference in color of its acid and alkaline solutions.

**Indifferent Gas.** A gas which does not react chemically with the system under observation.

**Indissoluble.** Insoluble.

**Indium.** Metallic element. In. At. Wt. 114.8. S. G. 7.12. Sp. heat 0.05695. M. P. 115°. Valence, 3. Oxide  $\text{In}_2\text{O}_3$ . Occurs in zinc blende.

**Indoanilines.** Compounds formed like the indophenols (q.v.) but by replacing the para hydrogen of the anil group with  $\text{NH}_2$  instead of  $\text{OH}$ . They are dyestuffs, ex. quinoneanilimide,  $\text{C}_6\text{H}_4\text{—N—C}_6\text{H}_4\text{—NH}_2$ .



**Indophenols.** Phenolic compounds derived from quinone monanil



by replacing the para hydrogen of the anil group by hydroxyl, ex. quinone-phenolimide,



They form a series of dyestuffs.

**Inductance.** The electrification of a conductor placed near an electric charge, as a charged body, or near an electric circuit.

**Induction, Apparent, Period of.** A false period of induction. A reaction measured by the rate of evolution of a gas from a liquid frequently shows an apparent period of induction due to retention of gas by the liquid.

**Induction Factor.** The proportion in which the actor divides itself between the inductor and acceptor in an induced reaction.

$$I = \frac{\text{amount of acceptor transformed}}{\text{amount of inductor transformed}}$$

**Induction, Period of.** (Period of delayed action.) A period of acceleration of a chemical reaction from zero to a maximum found in many cases, often occupying measurable time, as in the combination of impure hydrogen and chlorine when exposed to light. It may be due to the main reaction being compounded of a number of consecutive reactions, overcoming passive resistance, catalysis, negative catalysis, etc. With photochemical reactions the phenomenon is known as the period of photochemical induction.

**Inductor.** In induced reactions, the substance which takes part in the primary reaction as distinguished from the actor which takes part in both.

**Indurated.** (bot.) Hardened.

**-Ine.** 1. The suffix used to denote hydrocarbons of the acetylene series, as ethine. 2. A suffix which denotes a strong nitrogen or organic base, as an amine or an alkaloid, as hydrazine, methylamine, morphine, brucine, pyridine, and atropine. Weak bases derived from plants, as caffeine, theobromine, etc., which are not usually classed as alkaloids may use either the suffix -in or -ine. Exceptions to the rule are known.

**Inert Substances.** Elements and compounds which react very slowly or not at all. Nitrogen is very inert. The noble gases are all completely inert.

**Inflorescence.** (bot.) The flowering part of a plant.

**Infusible.** Solid substances which cannot be liquefied by any means at our command.

**Infusion.** An aqueous solution of the soluble constituents of a plant made by immersing a quantity of the plant in boiling water, allowing the mixture to steep until cold, and strain-

ing off the liquid portion. Cf. decoc-tion.

**Inorganic.** 1. Not derived from a living organism. 2. Any chemical compound which does not contain carbon, except that carbonates, cy-anides, and a few other simple carbonic derivatives are usually considered inorganic in nature.

**Insoluble.** Not dissolving in a solvent (except in minute amounts).

**Interface.** A surface which forms the boundary between two phases or systems.

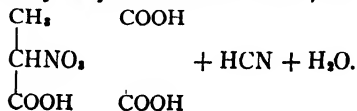
**Internal.** A term used to express the idea that a phenomenon is confined within a molecule, as internal com-pensation, internal oxidation.

**Intermolecular Actions.** Reactions between individual molecules. The usual kind of reaction. The term is used to distinguish these from intra-molecular reactions where the action takes place between portions of the same molecule.

**Intramolecular Reactions.** See in-termolecular actions.

**Intramolecular Oppositions.** (Inter-molecular oppositions.) Assumed ten-sions or oppositions between the ele-ments in a compound due to their potential differences.

**Intramolecular Oxidation.** The ox-idation of a compound in which the oxygen required by the reaction is furnished by the compound itself, e.g. nitrolactic acid oxidizes itself to oxalic and hydrocyanic acids and water, viz.,



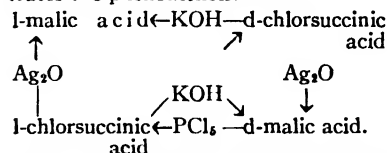
**Invasion.** The solution of a gas in a liquid. See absorption of gases.

**Inversion.** (To invert.) 1. To con-vert a stereochemical isomer into its opposite form, as a laevorotatory to a dextrorotatory substance or a cis to a trans form. 2. To decompose, as by hydrolysis, an optically active substance producing an oppositely optically active substance, e.g. the inversion of dextrorotatory saccharose to a laevorotatory mixture of dextrose and levulose.

**Inversion, Geometrical.** The con-version of a geometrical isomer into its opposite form by physical or chemi-cal means. Fumaric acid, on heating, is converted into the anhydride of maleic acid; nitrous acid converts oleic into elaidic acid.

**Inversion, Optical.** The conversion of optically active substances into derivatives of identical structure but of opposite rotation. l-malic acid with phosphorus pentachloride yields d-chlorsuccinic acid; d-malic acid under the same conditions yields l-chlor-succinic acid. Walden's inversion is the classical instance of optical in-version.

**Inversion, Walden's.** Optical in-version. The following scheme illus-trates the phenomenon:—



thus, l-malic acid may be converted into d-malic acid.

**Iodide.** A salt of hydriodic acid, as NaI. The iodides of mercury, lead, and silver are insoluble in water. All other common iodides are soluble.

**Iodine.** Non-metallic element. I. At. Wt. 126.92. Mol. Wt. 253.84. S. G. 4.984. Sp. heat 0.05412. M. P. 113.7°. B. P. 185.5°. Val-

ence 1. Oxides,  $I_2O$ ,  $I_2O_3$ ,  $I_2O_5$ .  
Acids,  $HI$ ,  $HIO$ ,  $HIO_3$ ,  $HIO_4$ .

**Iodine Carriers.** Substances added to organic reaction mixtures to cause combination of iodine with various compounds or to direct the course of the reaction in some specific way. Phosphorus, iron wire, ferrous iodide, aluminium iodide, ferric chloride, mercuric oxide, etc., are examples.

**Iodine Number.** (Iodine value, Hübl number.) A constant of unsaturated fats and waxes; numerically the percentage of iodine absorbed by the sample. Iodine chloride or bromide may be used in the determination of the constant, in which cases the results are calculated to iodine.

**Iodo Compounds.** (Iod compounds.) Organic compounds which may be regarded as derived from hydriodic acid, as iodobenzene,  $C_6H_5I$ , iodomethane,  $CH_3I$ .

**Iodonium Compounds.** Compounds derived from the hypothetical iodonium hydroxide:  $I.OH$ , as diphenyliodonium hydroxide,  $(C_6H_5)_2I.OH$ , and diphenyliodonium iodide,  $(C_6H_5)_2I.I$ .

**Iodoso Compounds.** Organic compounds which contain the group  $-IO$ , as iodosobenzene,  $C_6H_5IO$ .

**Iodoxy Compounds.** Organic compounds which contain the group  $-IO_2$ , as iodoxybenzene,  $C_6H_5IO_2$ . Formerly termed iodo compounds.

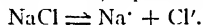
**Ionic Conductivity.** (1.) The part of the conductivity of any system due to anions ( $l_a$ ) or cations ( $l_c$ ). This value may be calculated as the product of the molecular conductivity and the migration ratio (Hittorf number) of the ion, e.g. in tenth normal solution the molecular conductivity of potassium chloride is 111.9 and the migration ratio of  $K^+$  is 0.492. The ionic

conductivity of  $K^+$  in N/10 solution is therefore  $111.9 \times 0.492 = 55$ .

**Ionic Mobility.** (U.) The velocity of an ion under a potential difference of one volt per centimeter.  $U_a$  = anionic mobility,  $U_c$  cationic mobility.

**Ionium.** A radioactive solid produced by the disintegration of uranium X. At. Wt. 230.5. Period of half-decay  $2 \times 10^5$  years. Emits  $\beta$  and  $\gamma$  rays, disintegrating into radium.

**Ionization.** 1. The charging of particles of a gas so that the gas becomes a conductor of the electric current. 2. "Dissociation," "Electrolytic dissociation," "Ionic dissociation," "Electrolytic ionization." The assumed splitting up of electrolytes in solution into equal numbers of anions and cations which are able to conduct the electric current, represented,



The term "dissociation" refers also to cases of molecular decomposition not connected with electrical changes (as usually understood) and is, therefore, being discarded in favor of "ionization" to describe ionic phenomena.

**Ionization Constant.** (Dissociation constant.  $K$ .) A constant which depends upon the equilibrium between the ions and the non-ionized molecules in solution, e.g.

$$K = \frac{C_a \cdot C_c'}{C_m}$$

where  $C_a$  equals the anionic concentration,  $C_c'$  the cationic concentration, and  $C_m$  the concentration of the non-ionized molecules. The constant may also be calculated from Ostwald's dilution law

$$\alpha = \frac{m^2}{(1-m)v}$$

where  $\alpha = K$ ,  $m$  the degree of ionization, and  $v$ , the volume of the solution. With weak electrolytes the numerical values for  $K$  at various dilutions are

quite constant; with strongly ionized substances, however, van't Hoff's formula,  $K = C_i^n/C_u$  (where  $C_i$  = ionic concentration,  $C_u$ , non-ionized molecules, and the value for  $n$  ranges from 1.43 to 1.56) gives better results.

**Ionization, Degree of.** (*m.*) (Degree of dissociation.) The proportion of a compound which is ionized at any temperature and dilution. Complete ionization is reached at infinite dilution at which, also, we obtain the limiting value for molecular conductivity ( $\mu_\infty$ ). The degree of ionization at any dilution ( $v$ ) may be calculated from the molecular conductivity at that dilution ( $\mu_v$ ) from the formula,  $m = \mu_\infty/\mu_v$ .

**Ionization, Heat of.** (*L.*) (Heat of dissociation.) The heat change which occurs when a compound ionizes in solution. If heat is absorbed during ionization, the ionization constant increases with rise of temperature and vice versa.

**Ionogenic.** Forming or furnishing ions, e.g. all electrolytes.

**Ions.** Electrically charged particles capable of conducting the electric current. Gases which conduct electricity have been shown to contain what are called gas ions, i.e. charged particles of the gas. Solutions of electrolytes are assumed to contain vast numbers of charged particles, some of them positively charged (cations) and an equal number negatively charged (anions) by which an electric current may be conducted through the liquid. Ions are designated by the usual chemical symbols followed by an index of their electrical nature; for cations a dot (·) or plus sign (+) and for anions an apostrophe (') or minus sign (−) are used, e.g.  $H^{\cdot}$  or  $H^+$ ;  $OH'$  or  $OH^-$ , the number of the indices corresponding to the valence of the ion, as  $Fe^{\cdot\cdot}$  and  $Fe^{\cdot\cdot\cdot}$ .

**Ions, Electrolytic.** Ions which occur in solutions of electrolytes.

**Ions, Gaseous.** Gas ions, see ions.

**Ions, Hydrated.** Ions supposed to be combined with ionization products of the solvents in which they are dissolved.

**Ions, Isomeric.** See isomerism, ionic.

**Ions, Zwitter.** Ions which are both positively and negatively charged at the same time, e.g. substances of the formula  $N(CH_3)_2-R-SO_3H$  which ionize to form  $NH(CH_3)_2-R-SO_3'$ . The resulting ion is derived from a sulphonic acid and a substituted ammonia.

**Iridi-.** A prefix which indicates a content of tetravalent iridium.

**Iridic.** A compound of iridium in which the metal is tetravalent.

**Iridious.** A compound of iridium in which the metal is divalent.

**Iridium.** Metallic element. Ir. At. Wt. 193.1. S. G. (crystalline) 22.42. Sp. heat 0.0323. M. P. 1950°. Found in platinum ores. Oxides  $Ir_2O_3$ ,  $IrO_2$ . Valence 2, 3, and 4.

**Irido-.** A prefix which indicates a content of divalent iridium.

**Iron.** Metallic element. Fe. (fer-*rum*). At. Wt. 55.85. S. G. 7.1. Sp. heat 0.1162. M. P. 1505° (steel, 1375°, wrought iron, 1600°). Valence 2 and 3. Forms two series of compounds, the ferrous and ferric. Oxides  $FeO$ ,  $Fe_2O_3$ ,  $Fe_3O_4$ . Ores, magnetite, hematite, limonite, franklinite, siderite, etc. Acid, ferric acid,  $H_2FeO_4$  known only in its salts.

**Isidioms.** A term suggested by Ladenburg to describe compounds and elements which behave in a similar

chemical manner but are, in the case of compounds, differently constituted, as pseudotropine and scopoline, cobalt and nickel, niobium and tantalum, benzene and thiophene.

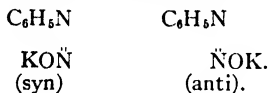
**Iso-.** A prefix which indicates identity or equality, as isothermal, isodynamic, and isomer, and also to denote isomerism, as isoheptane, an isomer of heptane.

**Isochores.** Curves obtained from varying pressure of liquids and gases at constant volume.

**Isochore of Reaction.** See reaction isochore.

**Isocyanide.** An isonitrile (q.v.).

**Isodiazo Salts.** Compounds formed by the rearrangement of diazo metallic salts. The isomerism between the two classes of compounds is considered as due to syn and anti forms, e.g.



**Isodimorphism.** (Double isomorphism.) The condition in which both crystalline forms of a dimorphous substance which is isomorphous with a second dimorphous compound are isomorphous with both forms of the second compound. Ex., arsenious oxide and antimonious oxide, which crystallize in rhombs and also in regular octahedra.

**Isodynamic.** Furnishing the same amount of energy in the organism. 100 gm. of fat are isodynamic with about 230 of protein or carbohydrate.

**Isoelectric Point.** The point of electric neutrality or zero potential.

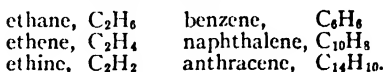
**Isohydric Solutions.** Solutions which possess the same concentration of hydrogen ions. They may be

mixed without alteration of the degree of ionization of either solute. By extension the term is applied to all solutions which have a common ion in the same concentration.

**Isolable.** Capable of being isolated or obtained in a pure condition.

**Isolate.** To separate in a pure condition from all foreign admixture, as, to isolate an alkaloid.

**Isologous Series.** Carbon compounds, alike chemically, but differing from one another in composition by a difference other than  $n\text{CH}_2$  (characteristic of homology) are isologous and form an isologous series, as



**Isologue.** A member of an isologous series.

**Isology.** The relationship between isologous substances.

**Isomer.** A compound which has the same percentage composition of the same elements as some other compound. It need not necessarily have the same molecular weight (see isomerism). Isomers are usually distinguished by different chemical properties but this is not always the case, especially among optical isomers. Termed also isomeride.

**Isomer, Physical.** See isomerism, physical.

**Isomeric.** 1. Pertaining to isomers. 2. Exhibiting isomerism.

**Isomeric Ions.** (Ionic isomers.) See isomerism, ionic.

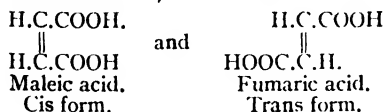
**Isomeride.** An isomer (q.v.).

**Isomerism.** A phenomenon due to the structure of chemical compounds in which two or more compounds of

different properties may possess identical ultimate compositions, e.g. two substances of the formula  $C_4H_{10}$  are known, viz., butane,  $CH_3CH_2CH_2CH_3$ , and isobutane  $(CH_3)_2CHCH_3$ . Two kinds of isomerism have been distinguished; if the isomers are of like molecular weight, as in the illustration, they are termed metamers, are metameric, and the phenomenon is known as metamerism: if the isomers are of different molecular weights, as benzene,  $C_6H_6$ , and acetylene,  $C_2H_2$ , they are termed polymers (benzol is polymeric with acetylene), and the phenomenon is known as polymerism. (See polymerization.) In modern organic chemistry polymerism is treated separately and isomerism is usually restricted to compounds of like molecular weight.

**Isomerism, Chain.** (Nucleus isomerism.) Isomerism due to conditions in the chain (or nucleus) of carbon compounds as distinguished from position isomerism. Forked chains and ring-shaped structures are examples of nucleus isomerism.

**Isomerism, Cis-Trans.** (Ethylene isomerism. Alloisomerism.) Geometrical isomerism of carbon compounds not dependent upon nitrogen content. Thus,



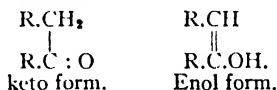
**Isomerism, Dynamic.** 1. (Energy isomerism. Dynamical isomerism.) Isomerism due to difference in internal energy between isomers. 2. (Tautomerism, tautomerism, pseudomerism, desmotropy, desmotropism, merotropy.) Isomerism due to intramolecular rearrangements by virtue of which one substance may react in accordance with two structural formulas, viz., cyanamide may react as

$N:C.NH_2^{\overset{+}{1}}$  or  $HN:C:NH$ . The terms dynamic isomerism and desmotropism have also been applied to the cases where the two forms have been found to exist; these are commonly interconvertible.

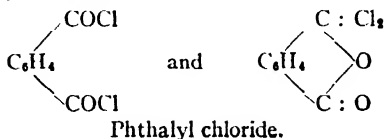
**Isomerism, Geometrical** Isomerism between unsaturated and optically inactive compounds due to the relative spacial positions of various groups attached to the same nucleus. Cis-trans and syn-anti isomerism are examples.

**Isomerism, Ionic.** 1. The isomerism of the acid and non-acid forms of pseudo-acids and the basic and non-basic forms of pseudo-ammonium bases. 2. Isomerism between ions due to valence differences, as  $Fe^{++}$  and  $Fe^{+++}$ ,  $Cr^{++}$  and  $Cr^{+++}$ . These ions are considered isomeric and are termed ionic isomers.

**Isomerism, Keto-Enol Tautomerism.** A type of isomerism observed in certain carbonyl containing compounds in which, by intramolecular change, an hydrogen from an adjacent carbon atom combines with the carbonyl oxygen with consequent production of a double bond between the carbon atoms concerned, viz.,



**Isomerism, Lactone Tautomerism.** Dynamic isomerism between groups in the  $\gamma$  position in alicyclic and in the ortho position in carbocyclic compounds, as



**Isomerism, Nucleus.** See isomerism, chain.

**Isomerism, Optical.** A type of isomerism in which the isomers are identical in composition, constitution, molecular weight, chemical properties, and most physical properties and differ only in the way their solutions (or liquid states) affect the ray of polarized light. The plane of the ray may be rotated to the right when the substance is termed the dextrorotatory (*d*) form; to the left, when the substance is termed the laevorotatory (*l*) form; or the ray may not be affected, when the substance is termed inactive. Such inactivity may be due to several causes; the substance may be a molecular mixture of the opposite forms (*dl*), or it may be a racemic mixture (*r*), or it may be a meso form inactive by internal compensation. The active isomers are variously termed enantiomorphs, antipodes, and active components.

**Isomerism, Physical.** 1. Geometrical isomerism. 2. Polymorphism.

**Isomerism, Place.** (Position isomerism.) Isomerism due to the position assumed by a substituent, or to the relative positions of two or more substituents, e.g. the isomerism between propyl and isopropyl chlorides and the isomerism between ortho, meta, para, etc., derivatives of cyclic nuclei. Cf. isomerism, chain.

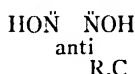
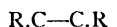
**Isomerism, Stereochemical.** (Stereoisomerism.) Isomerism due to the relative positions in space assumed by the constituent elements and groups. The term includes geometrical and optical isomerism.

**Isomerism, Syn-Anti.** Geometrical isomerism of nitrogen-carbon compounds, e.g. with monoximes,

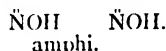
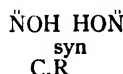


Benzsynaldoxime  
anti form.

and with dioximes, e.g. benzildioximes,



benzantialdoxime.  
syn form.

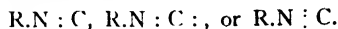


**Isomeromorphism.** Isomorphism between isomeric substances.

**Isomorphic.** (Isomorphous.) Exhibiting isomorphism.

**Isomorphism.** A condition of identity of crystal form shown by many different substances. The crystals of the different isomorphous compounds must show complete coincidence of the properties of symmetry and approximate coincidence of geometrical constants. They show the phenomenon of mutual overgrowth and form mixed crystals. Ex., the sulphates of the alkali metals are all isomorphic; they all crystallize in the rhombic system and show little variation in geometrical constants.

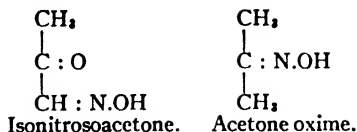
**Isonitriles.** (Carbylamines, isocyanides.) Compounds of the general formula  $RNC$ , as ethyl isocyanide,  $C_2H_5.NC$ . They may be structurally represented as



The isonitriles are very toxic, colorless liquids of disgusting odor.

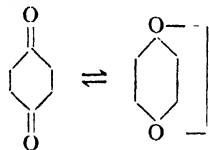
**Isonitroso Compounds.** (Oximido.) Compounds which contain the group  $:N.OH$  other than the oximes to which they are related. They may be regarded as the oximes of ketone aldehydes or acids, viz.,



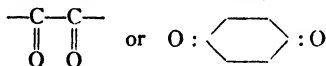


**Isonuclear.** Occurring in the same nucleus. See naphthalene and heteronuclear.

**Isorropesis.** A recurrent making and breaking of linkages in certain non-tautomeric organic compounds, assumed to account for vibrational disturbances in the valency electrons, e.g. in quinone



**Isorropic Band.** A band found in the spectra of compounds which contain either of the groupings



and having its head situated approximately at 2000 units.

**Isosmotic.** (Iso-osmotic.) Solutions which have the same osmotic pressure. Isotonic solutions are isosmotic with physiological liquids or cells. Hypertonic and hypotonic liquids are of lower and higher osmotic pressures respectively than the cells with which they are compared.

**Isosteres.** Pairs of compounds which show notable agreement in physical properties (as carbon dioxide and nitrous oxide; carbon monoxide and nitrogen) and which (according to the octet theory) have the same number and arrangement of electrons in the molecule. The term applies also to radicals and groups of atoms which

hold pairs of electrons in common. These are termed isosteric compounds and the phenomenon is called isosterism (Langmuir).

**Isosteric.** See isosteres.

**Isosterism.** See isosteres.

**Isothermal.** Of constant temperature. Isothermal processes are those conducted without temperature change, e.g. isothermal distillation.

**Isothermals.** Lines or curves which denote regions of equal temperature, especially on the pressure-volume diagram, the lines which denote the boundary between phases under varying pressure and volume at constant temperature.

**Isothermal Work.** The work a gas does in expanding at constant temperature, given by the equation,  $A = RT \ln(P_1/P_2)$  where  $P_1$  and  $P_2$  are the initial and final pressures respectively.

**Isothermic.** Isothermal.

**Isotopes.** Radioactive elements which occupy the same positions in the periodic table and which cannot be separated from one another by any known chemical process. Ionium, thorium, and radio-thorium are isotopes, as are meso-thorium and radium, and the several radioactive forms of lead.

**Isotopic Elements.** See isotopes.

**Isotrimorphism.** (Triple isomorphism.) The condition in which two isomorphous substances are each trimorphous and each of the three pairs of forms is isomorphous. Cf. isodimorphism.

**Isotropism.** (Isotropy.) The property possessed by most liquids and gases under ordinary circumstances and by some solids of exhibiting no

difference in the physical properties of a spherical portion when it is tested in different directions. The correlative terms are acolotropic and anisotropic.

**-Ite.** 1. A suffix used to indicate salts of "-ous" acids. 2. A suffix used to denote minerals, as granite, thorite, aragonite.

## J.

**Joint Effect of Two Catalysts.** If two catalysts influence the same reaction and both are added to the reaction mixture the phenomena of joint effect arise. This is sometimes the sum of their separate effects but is often greater or less than the sum, e.g. an acceleration or retardation may be produced. Naphthalene is oxidized more quickly by sulphuric acid in the presence of a mixture of cupric and mercuric sulphates than is accounted for by the sum of their separate effects.

**Joule, The.** (j.) A unit of work equal to ten million ergs.

1 joule = 9.2391 calories.  
1 " = 1 volt-coulomb.  
3600 joules = 1 watt-hour (1 kelvin).  
1 calorie = 4.183 joules.

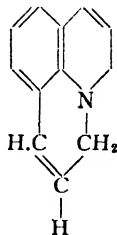
The kilojoule (1,000 joules) is often abbreviated J. and this may cause confusion with the smaller unit; Kj. is a better symbol.

**Joule's Law.** See law of Joule.

**Joule-Thompson Effect.** In passing a gas at high pressure through a porous plug of cotton into the atmosphere, a difference of temperature between the compressed and released gas may be noticed. Hydrogen becomes warmer and all other gases cooler. With a perfect gas no difference should be observed. This phenomenon is called the Joule-Thompson effect. It indicates intermolecular action in the gas.

**Julius' Chloride of Carbon.** Hexachlorbenzene.

**Julole Compounds.** Derivatives of the hypothetical julole:



## K.

**Kalium.** Latin name of potassium.

**Kata-.** (Cata-.) A prefix, from the Greek, which indicates "down," "below," "under," "opposed to," etc.

**Kataphoresis.** (Cataphoresis.) The migration of a sol through its medium towards anode or cathode under the influence of an electric charge. It is due to the establishment of potential differences at the interface between liquid and solid which results in displacement of one phase against the other when electricity is passed through the system or it is electrified. Positive sols (metallic hydroxides, etc.) migrate to the cathode and negative sols (metals, etc.) migrate to the anode. Called also electroendosmosis.

**Kations.** Cations, q.v.

**Ketazines.** Nitrogenous derivatives of the ketones, of the general type,



in which R represents an univalent aryl or alkyl group. Ex. dimethylketazine,



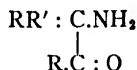
**Ketines.** Alkyl or aryl derivatives of pyrazine,



$\alpha$ ,  $\gamma$ , dimethylpyrazine (ketine) furnishes the name for the class.

**Keto-.** A prefix which indicates content of the carbonyl group ( $C : O$ ) which confers ketonic properties.

**Ketoamines.** Amino derivatives of the ketones, of the general type,



in which R represents alkyl or aryl group.

**Keto-Hexoses.** Ketone hexoses. Six carbon monosaccharoses which contain a carbonyl group, e.g. fructose.

**Ketols, Saturated.** Ketone alcohols of the general type,  $R.C : O.CH_2OH$ , e.g. acetol,  $CH_3.C : O.CH_2OH$ .

**Ketols, Unsaturated.** (Acvinyl alcohols.) Oxymethylene ketones of the general type,  $R.C : O.C(R') : CHO.H$ , in which R represents alkyl or aryl groups and R' may be hydrogen, e.g. oxymethylene acetone,  $CH_3.CO.CH : CHO.H$ .

**Ketones.** Organic compounds characterized by content of the carbonyl group as acetone,  $(CH_3)_2 : C : O$ . The ketones are named, 1. by combining the names of the alkyls with "ketone," as dimethyl ketone, methyl-ethyl ketone, etc., 2. the Geneva names are formed by adding the suffix "on" to the root of the parent hydrocarbon. Thus, acetone is propanon, methyl-ethyl ketone is butanon. Simple ketones contain two alkyl groups of one kind; in mixed ketones the alkyl groups are different, e.g. methyl-ethyl ketone. Aryl groups may in every case replace the alkyl.

**Ketose.** Any sugar which contains a carbonyl group.

**Ketoside.** Any glucoside which on hydrolysis yields a ketose, e.g. methylfructoside.

**Ketoximes.** Oximes of the ketones, of the general type,  $(R)_2C : N.OH$ , e.g. acetoxime,  $(CH_3)_2C : N.OH$ . They readily undergo the Beckmann rearrangement and exhibit syn-anti isomerism.

**Kilo-** A Greek prefix which signifies one thousand as used in the metric system and for scientific units. When used alone it refers to one kilogram.

**Kilogram.** (Kilo.) A unit of mass in the metric system intended to be the mass of a cubic decimeter of water at  $4^\circ C$ .

- 1 kilo = 1,000 grams.
- 1 " = 2.2 pounds.
- 1 " = 2.67923 troy pounds.

**Kilogram-Meter.** A unit of work in the gravitational system defined as the work done in raising a mass of one kilogram through a distance of one meter against gravity. It equals 98,000,000 ergs, nearly 10 joules.

**Kilojoule.** (Kj.) See Joule.

**Kiloliter.** A unit of volume in the metric system defined as the volume of 1,000 liters.

- 1 kiloliter = 264.17 U. S. liquid gallons.
- 1 " = 283.774 U. S. bushels.

**Kilomayer.** (kmy.) See mayer.

**Kilometer.** (Km.) A unit of linear measure in the metric system defined as the length of 1,000 meters.

- 1 kilometer = 3,280.83 feet.
- 1 " = 0.62137 mile.
- 1 " = 1,093.611 yards.
- 1 mile = 1,60935 Km.

**Kilowatt.** (KW.) A c.g.s. unit of power equal to 1,000 watts, q.v.

- 1 kilowatt = 1,000 joules per second.
- 746 " = 1,000 horsepower.
- 1 " = 1.341 H.P.
- 1 " = 238.7 calories per sec.

**Kilowatt Hour.** (KWH.) A commercial unit of energy equal to 1,000 watt-hours or 3,600,000 joules.

**Kinergy.** A property of matter: the capacity for kinetic energy (Noyes).

**Kinetic Theory of Gases.** A theory which postulates that gaseous molecules are endowed with a motion of translation and that the spaces between the molecules are large in comparison with the size of the molecules. According to this theory gas pressure is due to the bombardment of these moving molecules on the walls of the container.

**Koettstorfer Number.** See saponification number.

**Krypton.** Gaseous element. Kr. At. Wt. 82.92. S. G. 40.78 ( $H = 1$ ). M. P.  $-169^\circ C$ . B. P.  $-152^\circ C$ . Forms no known compounds. 1,000,000 volumes of air contain (about) 0.05 vols.

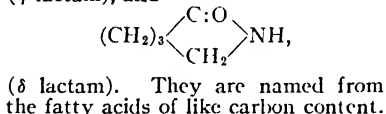
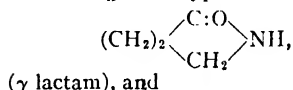
**Kyanize.** To protect against decay by saturating with aqueous mercuric chloride.

## L.

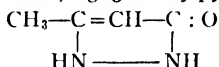
### 1-. Abbreviation for laevo.

**Labile.** A condition of a system or compound in which it is unstable, suffering conversion into a more stable form on slight disturbance. *Thermolabile*, modified by moderate heating, as certain isomers, enzymes, and bacteria.

**Lactams.** Cyclic amides derived from the  $\gamma$  and  $\delta$  amino-carboxylic acids by elimination of water—an intramolecular condensation. They correspond to the  $\gamma$  and  $\delta$  lactones and are of the general type

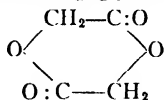


**Lactazams.** A lactam in which the lactam-nitrogen is joined to a second nitrogen atom, e.g. 3-methylpyrazolon.

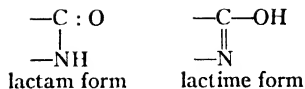


**Lactazones.** See lactoximes.

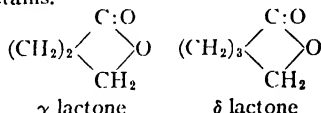
**Lactides.** Cyclic double esters of the  $\alpha$  oxy acids, e.g. glycolide,



**Lactimes.** Cyclic compounds, isomeric with the lactams of which they are the enol forms.

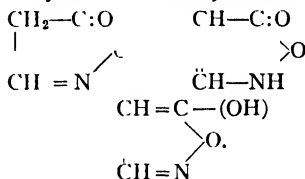


**Lactones.** Cyclic esters of the  $\gamma$  and  $\delta$  oxyacids, distinguished as  $\gamma$  and  $\delta$  lactones. They are produced by an intramolecular condensation of the oxyacids, water being eliminated. Cf. lactams.



They are named either from the corresponding acid or (Geneva) by adding the suffix "olid" to the stem of the parent hydrocarbon, as butanolid.

**Lactoximes.** (Lactazones. Isoxazolons.) Cyclic keto derivatives of the hypothetical dihydroisoxazole. They can be variously formulated,



**Laevo-.** (Levo. l.) A prefix which indicates that the compound is an optical isomer and rotates the plane of polarized light to the left. Sometimes used for inactive compounds derived from laevorotatory substances.

**Laevogryate.** (Laevogyre.) Laevorotatory.

**Laevorotatory.** See isomerism, optical.

**Lake.** A precipitate consisting of a metallic compound of a coloring matter, e.g. alizarine produces blue lakes with calcium and barium, reddish with aluminium and tin, black-violet with ferric iron, and violet-brown with chromium.

**Lanthanum.** Metallic element. La. At. Wt. 139. S. G. 6.1545. S. heat 0.04485. M. P.  $810^{\circ}$ . Occurs in cerite and samarskite. Valence 3. Oxide,  $\text{La}_2\text{O}_3$ .

### Laws.

**Law of the Appearance of Unstable Forms.** The unstable forms of monotropic substances are obtained from a liquid or vapor state before the stable form appears.

**Law of Avogadro.** See Avogadro's hypothesis.

**Laws of Balfour Stewart and Kirchhoff.** (Stewart-Kirchhoff laws.) 1. Light of any wave-length which has been emitted by a gaseous body can be absorbed by the same body at a lower temperature. 2. The ratio between the emissive and absorptive powers of any body is a function of the temperature only and is the same for all bodies which emit temperature radiations.

**Law of Beer.** The intensity of the color of light transmitted through a solution is proportional to the concentration of the solution. Hydrolysis, ionization, association, and alteration of the solvent cause exceptions to this law.

**Law, Behring's.** The blood serum of an animal which has been artificially rendered immune against a certain infectious disease, when injected into the body of another animal, has power to protect the latter individual against the same disease and to cure the disease after infection has occurred. Holds also for the toxalbumins ricin and abrin.

**Law, Blagden's.** The depression of the freezing point of a solution is,

for small concentrations, proportional to the amount of dissolved substance. Cf. law of Wüllner.

**Law of Berthollet.** Different substances have different affinities for each other; these exhibit their value only when they are in immediate contact with each other. The condition of equilibrium depends not only upon the chemical affinity but also upon the relative masses of the reacting substances. Cf. Berthollet's rule.

**Law of Boyle.** (Mariotte's law. Law of Boyle-Mariotte.) At constant temperature the volume of a gas varies inversely as the pressure exerted upon it, or  $PV = \text{a constant}$ . The law holds only for perfect gases; those which are easily liquefied show considerable divergence.

**Law of Brewster.** When light falls upon a transparent substance at the polarizing angle the reflected and refracted beams are at right angles to each other.

**Law of Charles.** See law of Gay-Lussac (1).

**Law of Chemical Kinetics.** The mass law. See law of Guldberg and Waage.

**Law of Clausius.** The specific heat of a perfect gas at constant volume is independent of the temperature.

**Law of Combining Volumes.** See law of Gay-Lussac (2).

**Law of Combining Weights.** Substances unite only in the ratio of their combining weights.

**Law of the Conservation of Capacities.** In any given system the sum of the capacities remains constant throughout any possible change. This is a special case of the law of conservation of mass.

**Law of the Conservation of the Elements.** It is impossible to transform one element into another element. (In the light of certain phenomena associated with radioactivity this law appears to require modification.)

**Law of the Conservation of Energy.**

(First law, first law of energy, first law of energetics, first law of thermodynamics, law of the conservation of force, law of the indestructibility of energy.) This law may be stated in several ways: 1. Energy can neither be created nor destroyed; 2. The energy of an isolated system remains constant; 3. If a system be subjected to a reversible process, the energy change involved in proceeding from state A to state B of the system is exactly equal to the energy change involved in returning from state B to state A.

**Law of the Conservation of Matter.** (Law of the conservation of mass. Law of the indestructibility of matter.) Matter (or mass) can neither be created nor destroyed.

**Law of Constant Composition.** See law of definite proportions.

**Law of Constant Heat Summation.** (Law of Hess.) The energy change involved in a chemical reaction or series of reactions in going from the initial condition of the system to the final condition is always the same and is independent of the course the reaction takes.

**Law of Constant Proportions.** See law of definite proportions.

**Laws of Coulomb.** 1. (Electrostatic law.) The force between two charged spheres is directly proportional to the product of the charges and inversely proportional to the square of the distance between their centers. 2. (Magnetic law.) The force of attraction or repulsion between two magnetic poles is directly proportional to the product of the pole strengths and inversely proportional to the square of the distance between them.

**Law of Dalton.** The pressure exerted by a mixture of gases which do not react upon each other is equal to the sum of the pressures which each gas would exert separately if it were alone in the containing vessel at the given temperature, that is, in a mixture each gas behaves as if it were alone. Cf. law of Gay-Lussac (1).

**Law of Definite Proportions.** (Law of constant proportions, law of constant composition, Proust's law.) Any specific compound always contains the same kind of elements in the same proportions.

**Law of the Degradation of Energy.** (Second law of thermodynamics, second law of energy.) It is impossible for an automatic machine to convey heat from one body to another at a higher temperature if it be unaided by any external agent, i.e. heat will not flow spontaneously from a colder to a warmer body. Another statement of the law is, the entropy of an isolated system tends to increase.

**Law, Dilution.** (Ostwald's dilution law.) The greater the dilution of a solution of an ionizable substance the greater will be the amount split into ions. Where  $\alpha$  = the degree of ionization and  $V$  the volume of the solution,

$$K = \frac{\alpha^2}{(1 - \alpha)V}$$

This holds well for dilute solutions but does not hold for strong solutions. There are several modifications of this law but none of them holds well for all conditions.

**Law of the Displacement of Equilibrium.** See law of Le Chatelier.

**Law, Distribution.** (The partition law, distribution law of Nernst.) If two nearly immiscible liquids are in contact and a substance which is soluble in both liquids be added to the system it will be distributed between them in such a sense that the ratio of the concentrations of the two solutions formed is a constant regardless of the quantity of solute. (N.B. Measurable deviations from this law take place, especially in concentrated solutions, due to association, ionization, chemical action, etc.) The constant is termed the distribution ratio, constant, or coefficient, and the partition coefficient.

**Laws of Draper.** 1. All solid and



liquid substances radiate light of shorter wave-lengths with increasing temperature. 2. The photochemical action of light is in proportion to its intensity.

**Law of Du Fay.** Electricities of like kind repel each other; those of unlike kind attract each other.

**Law of Dulong and Petit.** The products of the atomic weights and the specific heats of the elements (i.e. their atomic heats or thermal capacities) have nearly always the same numerical value, about 6.4. At ordinary temperatures the values for silicon, boron, glucinum, and carbon are very much lower but at high temperatures the figures rise nearly to 6.

**Law of Electrolysis.** See laws of Faraday.

**Law of Equilibrium.** Whatever is in equilibrium in one way must be in equilibrium in every way.

**Law of Equivalent Ratios.** } See  
**Law of Equivalent Weights.** } Law of Richter.

**Law of Esterification.** (Victor Meyer's esterification law.) When the hydrogen atoms in the two positions ortho to the carboxyl in a substituted benzoic acid are replaced by radicals such as chlorine, bromine, nitro, methyl, and carboxyl, an acid results which can be esterified by means of hydrochloric acid and alcohol only with difficulty or not at all.

**Law of Even Atoms.** The sum of the valences of all atoms combined with carbon in an organic compound must be an even number. Triphenylmethyl is an exception.

**Laws of Faraday.** 1. The quantity of an electrolyte decomposed by the passage of an electric current is proportional to the quantity of electricity which passes. 2. The mass of any ion liberated by a given quantity of electricity is proportional to the chemical equivalent weight of the ion.

**Law, Gas.** (The gas law.) The volume which a given mass of gas occupies is dependent upon a definite

relation of temperature and pressure, i.e.  $V = RT/P$ , where  $R$  is a factor termed the gas constant (q.v.). See also van der Waal's equation, under equation.

**Law of Gas Volumes.** See law of Gay-Lussac (1).

**Laws of Gay-Lussac.** 1. (Law of gas volumes, law of Charles, law of Dalton.) The volume of a gas increases  $1/273$  of its volume at  $0^\circ \text{C}$ . for a rise of one degree centigrade, and the pressure exerted by a gas increases  $1/273$  of the pressure it exerts at  $0^\circ \text{C}$ . per rise of one degree at constant volume. 2. (Combining volumes.) The ratio between the volumes of reacting gases and the volumes of their products (in the form of gases) is simple and can be expressed by small whole numbers.

**Law, Graham's.** The relative rates at which gases diffuse are inversely proportional to the square roots of their relative densities.

**Law of Guldberg and Waage.** (Law of mass action, law of mass effect, law of chemical kinetics, the mass law.) The velocity of a chemical reaction is proportional to the active masses of the reacting substances. For irreversible reactions,  $V_t = K(a - x)/(b - x)$ , and for reversible reactions,  $V_t = v - v' = kc_1c_2 - k'c_1'c_2'$ , where  $V_t$  is the velocity at any given time,  $x$ , the amount of  $a$  and  $b$  transformed in time  $t$ ,  $v$  and  $v'$ , the velocities of the opposing reactions,  $c_1$ ,  $c_2$ ,  $c_1'$ , and  $c_2'$  the concentrations of the factors of the opposing reactions, i.e.  $c_1$  and  $c_2$  might be substituted for  $(a - x)$  and  $(b - x)$ .  $K$ ,  $k$ , and  $k'$  are the velocity constants of the reaction.

**Law of Haüy.** Every crystalline substance of definite chemical composition has a specific crystalline form characteristic of that substance.

**Law of Hess.** See law of constant heat summation.

**Law of Helmholtz.** See law of Thompson.

**Law of Henry.** The amount of a gas dissolved by a liquid with which it does not unite chemically is directly proportional to the pressure of the gas.

**Law of the Impenetrability of Matter.** Two bodies cannot occupy the same space at the same time.

Law of **Intermediate Reactions.** }  
Law of **Intermediate Stages.** }

See law of successive reactions.

**Laws of Joule.** 1. The heat produced by a current is proportional to the square of the current and the time during which it flows, or  $H = RI^2t$ . 2. (Kopp's law or rule, Woestyn's law or rule.) The molecular heat of a solid compound is approximately the sum of the atomic heats of its constituent elements.

**Laws of Kirchhoff.** 1. If several conductors meet at a point the algebraic sum of all the currents flowing toward the point is zero. (Currents flowing away from the point are taken as negative quantities.) 2. In any closed circuit the sum of the electromotive forces in the circuit equals the sum of the products of the resistance in each part into the current flowing through it.

**Law of Kohlrausch.** The conductivity of a neutral salt in dilute solution is the sum of two values, one of which depends upon the cation, the other upon the anion.

**Law, Kopp's.** In organic compounds equal differences in chemical composition correspond to equal differences in boiling point. (Cf. law of Joule (2).)

**Law of Landolt-Oudemán.** See law of Oudemán.

**Law of Le Chatelier.** If a system in physical or chemical equilibrium be subjected to a stress involving a change of temperature, pressure, concentration, or similar stress, the state of the system will automatically tend to alter so as to minimize (or undo) the effect of the stress.

Law of **Mass Action.** } See law of  
Law of **Mass Effect.** } Guldberg  
and Waage.

**Law of Mitscherlich.** The same

number of atoms combined in the same manner produce the same crystalline form; the crystalline form is independent of the chemical nature of the atoms and is determined solely by their number and mode of combination.

**Law of Moduli, Valsøns.** For moderate concentrations, the densities of salt solutions show constant differences for substitutions of anion or cation, i.e. the difference in density of normal solutions of potassium and ammonium salts of the same acid is 0.280 to 0.288; and that between chlorides and nitrates of the same base in normal solution is 0.0141 to 0.0150.

**Law of Multiple Proportions.** When two elements combine in more than one proportion the quantities of the first which are combined with the same amount of the second stand in the ratio of small whole numbers.

**Law of the Mutuality of Phases.** If two phases, respecting a certain definite reaction, at a certain temperature, are in equilibrium with a third phase, then at the given temperature and respecting the same reaction, they are in equilibrium with each other.

**Law of Nernst.** See law, distribution.

**Law of Neumann.** The product of the molecular weight into the specific heat, i.e. the molar heat, of compounds of analogous composition is nearly constant.

**Law of Octaves.** Newland's name for his hypothesis of the periodic system.

**Law of Ohm.** The current ( $I$ ) flowing through a conductor is proportional to the difference of potential ( $E$ ), and inversely proportional to the resistance ( $R$ ) of the conductor, or  $I = E/R$ .

**Law of Oudemán.** (Law of Landolt-Oudemán.) The molecular rotations of the salts of optically active acids or bases always tend to a definite limiting value as the concentration of the solution diminishes. E.g. the soluble salts of  $\alpha$  bromsulphocamphoric

acid show identical molecular rotations in hundredth normal solutions.

**Law of Partial Pressures.** See law of Dalton.

**Law, Partition.** See law, distribution.

**Law of Peptic Activity.** The amount of coagulated protein digested by a peptase is proportional to the time.

**Law, Periodic.** The properties of the elements are the periodic functions of their atomic weights.

**Law of Photochemical Action.** See law of Draper (2).

**Law of Proportionality.** See law of Richter.

**Law of Proust.** See law of definite proportions.

**Law of Raoult.** If molecular amounts of different substances be dissolved in the same weight of the same solvent the depression of the freezing point is the same in all cases. (This holds for all non-ionized substances.) (Cf. law of Blagden.)

**Law of Reciprocal Proportions.** (Law of equivalent proportions.) The weights, or their multiples and sub-multiples, of the elements which react with a definite fixed weight of another element, also react with each other. (Cf. law of Richter.)

**Law of Retgers.** The physical properties of isomorphous mixtures are continuous functions of the percentage composition.

**Law of Richter.** (Law of Wenzel. Law of proportionality. Law of equivalent ratios.) The weights of various acids which will neutralize a certain fixed weight of one of the bases will neutralize certain fixed weights of all the bases and the bases will neutralize the acids according to the same weights, i.e. each acid and base may be assigned an equivalent weight. Cf. law of reciprocal proportions.

**Law of Robin.** When a system is in a condition of either chemical or physical equilibrium an increase of pressure favors the system formed with

a decrease in volume; a reduction in pressure favors the system formed with an increase in volume; and a change of pressure has no effect upon a system formed without a change in volume.

**Law of Schönbein.** When certain substances are spontaneously oxidized by atmospheric oxygen just as much oxygen is rendered "active" as is "bound." See autoxidation.

**Law of Schütz and Borrisow.** The amount of material digested by an enzyme is proportional to the square root of the amount of enzyme. Where  $t = 24$  hours,  $C_f$  = concentration of the enzyme, and  $x$  = the amount digested,

$$x = tK\sqrt{C_f}.$$

Cf. law of peptic activity.

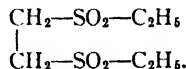
**Law of Specific Heats.** See law of Dulong and Petit.

**Law, Stefan's, of Total Radiation.** The total amount of energy radiated from a body that is emitting a series of different wave-lengths, the radiation being due to temperature alone, is proportional to the fourth power of the temperature of the body.

**Law of Stokes.** The maximum velocity which a sphere will reach in falling through a medium depends upon the viscosity of the medium and the radius of the sphere ( $a$ ). Thus, where  $\mu$  = the coefficient of viscosity of the medium,  $v$  the velocity, and  $g$  the gravitational constant,

$$v = \frac{2ga^2}{9\mu}.$$

**Law of Stuffer.** All sulphones in which sulphone groups are attached to two adjacent carbon atoms can be saponified, e.g. ethylene-diethyl sulphone,



**Law of Successive Reactions.** (Ostwald.) In the formation of a consecutive series of intermediate com-

compounds in a chemical process the compound which involves the smallest loss of free energy will be formed first, and the one which involves the next smallest loss of free energy second, and so on. This is also known as the law of intermediate reactions, or of intermediate stages.

**Law of the Thermoneutrality of Salt Solutions.** When dilute salt solutions are mixed and neither precipitate nor volatile compound is separated no heat change takes place.

**Law of the Transformation of Energy.** Energy in any form may be changed either directly or through intermediate stages into any other form of energy.

**Law of Thompson.** (Law of Helmholtz. Thompson's rule.) In a galvanic cell the heat of reaction is a direct measure of the electromotive force, i.e. the chemical energy is simply converted into electrical energy. This is only approximately true, for part of the energy of a galvanic cell appears as heat, either absorbed or evolved as the case may be.

**Law of Trouton.** The quotient of the molar heat of vaporization by the boiling point in absolute units is a constant.

**Law of Wenzel.** See law of Richter.

**Law of Widemann-Franz-Lorenz.** With all good conductors at the same temperature, the ratios of the thermal to the electrical conductivities are numerically identical; at different temperatures the ratio is proportional to the absolute temperature.

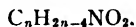
**Law of Wüllner.** The lowering of the vapor pressure of a solvent is approximately proportional to the quantity of solute dissolved in it if the quantity of solute be very small. Cf. law of Blagden.

**Lead.** (Plumbum.) Metallic element. Pb. At. Wt. 207.1. S. G. 11.34. S. heat 0.0310. M. P. 327°. B. P. 1580°. Occurs native, as sulphide, as carbonate, etc. Valence,

2 and 4. Forms two series of compounds the plumbic and plumbous. Oxides  $Pb_2O$ ,  $PbO$  (litharge),  $Pb_2O_3$ ,  $Pb_3O_4$  (minium),  $PbO_2$ . Metaplbmic acid,  $H_2PbO_3$ .

**Lecithoproteins.** Compounds of lecithins with proteins, as phosphatids. See proteins.

**Leuceins.** A series of unsaturated glycines of the general formula



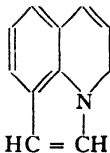
**Leuco Bases.** Colorless reduction products of certain dyestuffs, notably of the triphenylmethane derivatives, which on oxidation are converted back into the dyestuffs.

**Levigation.** The process of grinding a wet, insoluble substance to a fine powder. Sometimes applied to sedimentation.

**Light, Polarized.** Light is thought to be due to waves generated by the oscillations of electrons and is an electromagnetic phenomenon. When the magnetic vibrations occur in a single plane the light is said to be plane polarized. If the vibrations assume a circular path the light is said to be circularly polarized and if they assume elliptical paths the light is said to be elliptically polarized.

**Light, Velocity of.** 186,300 miles per second or 299,800 kilometers per second.

**Lilole Compounds.** Compounds derived from the hypothetical lilole,



**Limiting Curves.** On the pressure-temperature co-ordinate system the

plotted curves along which two different phases are coexistent.

**Linear.** 1. Pertaining to a line. 2. (bot.) A long, narrow leaf with parallel margins.

**Line Spectra.** Spectra which show lines as distinguished from band or continuous spectra.

**Linking.** (Linkage.) The bond used in constitutional formulas to represent one valency. Double and triple linkings refer to double and triple bonds.

**Linkage, Catenary.** The linking of molecules to one another end to end as occurs when amino acids unite to form polypeptides.

**Lipoproteins.** See proteins.

**Lithia.** Lithium carbonate.

**Lithic.** A compound of lithium.

**Lithium.** Metallic element. Li. At. Wt. 7.0. S. G. 0.534. S. heat 0.8366. M. P. 180°. B. P. above 1400°. Valence 1. Occurs in triphylite, petallite, spodumene, and lithi mica. Oxides,  $\text{Li}_2\text{O}$ ,  $\text{Li}_2\text{O}_2$ .

**Lithopone.** A mixture of barium sulphate and zinc sulphide used as a pigment, in oil cloth manufacture, and in compounding rubber.

**Liter-Atmosphere.** A unit of work defined as the work done in raising a piston of one square decimeter area one decimeter in a cylinder against an atmospheric pressure of one atmosphere.

1 liter-atmosphere = 24.25 gram calories

**Lixivial Salts.** Salts obtained by lixiviating ashes.

**Lixivation.** A process for separating soluble from insoluble matter by dissolving out the soluble substances

and drawing off the solution from the residue.

**Lixivium.** The solution obtained in lixiviation.

**Long's Coefficient.** See Häser's coefficient.

**Lorica.** A lute for protecting vessels from fire.

**Luminescence.** The property of emitting light in greater degree than corresponds to the temperature of the emitting body as defined by Stefan's law.

**Luminescence, Crystallo-.** Luminescence produced during the separation of crystals from saturated solutions. The phenomenon is shown by arsenious oxide, sodium fluoride, etc.

**Luminescence, Chemi-.** See chemiluminescence.

**Luminescence, Electro-.** Luminescence caused by electrical means, as the luminescence of rarified gases under the influence of a rapidly alternating high potential current.

**Luminescence, Thermal-.** Luminescence at temperatures below red heat as occurs in diamond, marble, and fluorite.

**Luminescence, Tribo-.** See triboluminescence.

**Luminophores.** Groups which confer or increase the property of luminescence in organic compounds. The amino and hydroxyl groups have this effect.

**Lunate.** (bot.) Crescent or half-moon shaped.

**Lute.** A sort of cement of refractory materials used for sealing the joints or openings of apparatus or for coating it to protect it from fire.

**Lutecium.** Metallic element. Lu.  
At. Wt. 175.

**Lyophile Systems.** Colloidal systems in which there is a marked affinity between the disperse phase and the dispersion medium. When the medium is water the term hydrophile is applied to the system.

**Lyophobic System.** The reverse of Lyophile. If water is the medium the term hydrophobe is applied to the system.

**Lyotrope Series.** (Lyotropic series.) A series of anions or cations arranged in the order of magnitude of their effect upon reactions in solutions. These ions indirectly influence a reaction by exerting a lyophile or lyophobe effect upon the solvent. In the hydrolysis of esters by bases we have the series,

Anions,  $I > NO_3 > Br > Cl$ .

Cations,  $Cs > Rb > K > Li$ .

## M.

**Macrochemistry.** The branch of chemistry which deals with substances in quantity as distinguished from microchemistry.

**Macrofarad.** A megafarad.

**Magistry of Bismuth.** Basic nitrate of bismuth, bismuth subnitrate,  $\text{Bi}(\text{OH})_2\text{NO}_3$ .

**Magistral.** An impure mixture of cupric and ferric salts used in the Mexican amalgamation process for silver.

**Magma.** An amorphous mass of finely divided material either wet or dry.

**Magnesian.** A salt of magnesium.

**Magnesium.** Metallic element. Mg. At. Wt. 24.32. S. G. 1.69-1.75. S. heat 0.2456. M. P. 632.6°. Valence 2. Oxides,  $\text{MgO}$  (magnesia),  $\text{MgO}_2$ ,  $\text{Mg}_3\text{O}_5(?)$ . Occurs abundantly in magnesite, dolomite, kieserite, epsomite, carnallite, asbestos, talc, meerschaum, and other minerals.

**Malenoid Form.** The cis form of geometrical isomerism. See isomerism, geometrical.

**Malonyl.** The divalent radical  $-\text{C}(\text{O}) : \text{C}=\text{CH}_2 - \text{C}(\text{O})-$  derived from malonic acid.

**Manganese.** (Manganium.) Metallic element. Mn. At. Wt. 54.93. S. G. 7.42. S. heat, 0.1217. M. P. 1207°. Valence 2, 4, and 6. Oxides,  $\text{MnO}$ ,  $\text{Mn}_3\text{O}_4$ ,  $\text{Mn}_2\text{O}_3$ ,  $\text{MnO}_2$ ,  $\text{MnO}_3$ ,  $\text{Mn}_2\text{O}_7$ . Chief ore, pyrolusite ( $\text{MnO}_2$ ). Forms two acids, pyromanganic  $\text{H}_2\text{MnO}_4$ , and permanganic  $\text{HMnO}_4$ .

**Manganic.** Salts of manganese in which the metal is quadrivalent, as  $\text{MnCl}_4$ .

**Manganium.** Latinized form of manganese.

**Manganous.** Salts of manganese in which the metal is divalent, as  $\text{MnCl}_2$ .

**Manocryometer.** An instrument invented by de Visser to determine the change in the melting point of a substance due to change in pressure. It consists of a thick-walled thermometer, inverted, with the capillary stem bent upwards and then bent at right angles. The substance under observation is placed in the bulb and mercury is admitted to the capillary. The whole is then placed in a thermostat, when it assumes the pressure (measured by the mercury) of equilibrium between solid and liquid in the bulb.

**Manoscopy.** The determination of the densities of gases.

**Markownikoff's Rule.** When an unsaturated molecule adds another molecular system at a low temperature, the most negative element or group combines with the least hydrogenated carbon atom or with that which already is in direct union with some negative element, but at comparatively higher temperatures the more positive element or group adds to the least hydrogenated carbon atom, i.e. the reaction proceeds in the opposite direction.

**Mass.** 1. A definite quantity of matter. The unit of mass is the gram or kilogram. The weight of a

body is the product of its mass and the acceleration due to gravity. 2. The cause of inertia

**Mass Action.** See law of Guldberg and Waage

**Mass, Conservation of.** See law of the conservation of matter.

**Matrass.** A flask (obs.)

**Matter.** That which occupies space or which can be perceived by our sense of touch. It presents itself in one of three states of aggregation, the solid, liquid, or gaseous

**Maximal Work, Principle of.** Every chemical change produces those substances which occasion the greatest development of heat. The "principle" is erroneous.

**Mayer.** (my.) A unit of heat capacity proposed by Richards<sub>2</sub> (Proc. Am. Acad. Arts and Sci. 36. 327 (1901). The mayer is that heat capacity which is warmed one degree centigrade by one joule. The heat capacity of one gram of water at 20° is about 4.181 mayers. The kilomayer (kmy)<sub>2</sub> equals one thousand mayers.

**Mean.** An average. An intermediate numerical value between two or more extremes or variables.

**Mean Free Path of Molecules.** The average distance travelled by a molecule of a gas or a substance in solution between collisions with other molecules. Where  $\lambda'$  = the cube which, in cross section, contains a molecule, and  $S$  = the distance of the centres of gravity of two molecules on collision, then

$$L = \frac{\lambda'}{4/3\pi S^2}$$

**Medium.** A substance through which a force is transmitted from one body to another.

**Megabar.** A unit of pressure equal to  $10^6$  dynes per square cm. or 750 mm. of mercury at 0° and 45° latitude at sea level. 1 megabar = 0.987 atmosphere

**Megadyne.** One thousand dynes.

**Megafarad.** (Macrofarad.) A unit of electrical capacity equal to one million farads.

**Megalerg.** One thousand ergs.

**Megameter.** A million meters or one thousand kilometers.

**Melt.** To fuse. To pass from the solid to the liquid state (see fusion). A "melt" is a fused mass.

**Melting Point.** 1. The temperature at which the solid and liquid states of a substance co-exist in equilibrium. The melting point is usually referred to normal pressure, 760 mm. Increase or decrease of pressure affects the melting point. If, at the melting point, the specific volume of the liquid is greater than that of the solid increase of pressure raises the melting point and decrease of pressure lowers it. 2. The "melting point" of liquid crystals is the temperature at which they lose their anisotropic properties.

**Meniscus.** The curved surface of a liquid particularly noticeable in vessels or tubes of small diameter and due to the surface tension of the liquid. If the liquid wets the containing vessel the meniscus is concave, otherwise it is convex. The meniscus of mercury in glass is convex.

**Menstruum.** A solvent, especially the solvent used in extracting drugs, which is often a complex mixture.

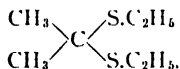
**Mercaptals.** (Thioacetals.) Sulphur compounds, analogous to the acetals, of the general form  $RS-CH_2-SR'$  where R and R' are identical or different alkyl or aryl groups.



**Mercaptans.** (Thioalcohols.) Organic compounds characterized by content of an  $-SH$  group, analogous to the alcohols from which they may be considered derived by the substitution of sulphur for hydroxyl oxygen, e.g. ethyl mercaptan,  $C_2H_5SH$ . They are liquids of extremely disgusting, garlic odor.

**Mercaptides.** Metallic derivatives of the mercaptans, e.g. mercury mercaptide,  $Hg(C_2H_5S)_2$ .

**Mercaptols.** Sulphur compounds formed by combination of ketones and mercaptans, as acetone ethyl mercaptol,



**Mercurammonium Compounds.** Ammoniacal derivatives of mercury, e.g. "infusible white precipitate"  $NH_2.HgCl$ , "fusible white precipitate"  $Hg(NH_4)_2Cl_2$ , etc.

**Mercuric.** Salts of mercury in which that metal is divalent, as  $HgCl_2$ .

**Mercurify.** To combine with mercury, to amalgamate.

**Mercurous.** Salts of mercury in which that metal may be regarded as univalent.

**Mercury.** (Hydrargyrum.) Liquid metallic element. Hg. At. Wt. 200. S. G. 13.59. S. heat, 0.03346. M. P.  $-38.85^\circ$ . B. P.  $357.33^\circ$ . Occurs native, as sulphide, in cinnabar etc. Valences 1 and 2. Alloys of mercury are termed amalgams. Oxides  $Hg_2O$ , and  $HgO$ . Mercury salts are poisonous.

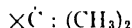
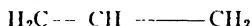
**Merochrome Compound.** A mixed crystal containing the true nitro form and the aci-nitro form of chromoisomers.

**Merotropy.** Michael's term for desmotropy. See isomerism, dynamic.

**Mes-.** } A prefix used to distinguish  
**Meso-.** } isomers especially those stereoisomers which are inactive by internal compensation from their active or racemic isomers, as mesotartaric acid.

**Meso Form.** See optical isomerism.

**Mesomethylene Carbon.** A carbon atom which forms a bridge across a ring and is linked to two methyl groups, as in camphane the carbon marked X,



**Met-.** } Prefixes used to distinguish  
**Meta-.** } nearly related compounds, as ortho-phosphoric and meta-phosphoric acids, and isomers especially carbocyclic derivatives where meta-denotes 1-3 substitution.

**Metabolism.** The conversion of chemical energy derived from food into heat, mechanical energy, etc. by living organisms. Metabolism may be resolved into two secondary processes, anabolism, or the synthesizing and storing of reserve food material and tissue building, and catabolism, or the decomposition of food into excretory products.

**Meta-Elements.** A term proposed by Crookes to denote fractional parts of an element which resemble each other much more closely than one ordinary element resembles another. He considered Yttrium an aggregate of eight of these meta-elements.

**Metal.** 1. Any element which can replace the hydrogen of an acid. 2. A member of a class of elements characterized by the possession of metallic lustre, ductility, malleability, high electric and thermal conductivity, and

chemically, of forming bases which can saturate acids. There is no sharp line of demarcation between metals and non-metals as many of the latter class possess some metallic properties. The property of forming cations may be considered characteristic of metallic elements. Metals transmit light only through extremely thin layers.

**Metalammines.** The metalammonium compounds.

**Metalammonium Compounds.** Complex metallic compounds which contain ammonium or its derivatives where the ammonium group acts like a metal, as the cobalt-ammonium, mercurammonium, etc. compounds.

**Metal, Earth.** Calcium, barium, or strontium. Also termed the alkaline earth metals.

**Metalepsy.** Dumas' term for substitution in organic chemistry.

**Metallic.** Pertaining to or containing a metal. Possessing the properties of a metal.

**Metalline.** 1. Resembling or pertaining to a metal. 2. Impregnated with metallic salts, as chalybeate water.

**Metalloid.** An old term for non-metal. (*obsolescent.*)

**Metal-Organic Compound.** A carbon compound, other than a salt, which contains a metal, as zinc ethide  $\text{Zn}(\text{C}_2\text{H}_5)_2$ , magnesium alkyl iodides, etc.

**Metals, Alkaline.** The metals which form water-soluble, alkaline carbonates, i.e. K, Na, Li, Cs, Rb, (and by analogy, ammonium).

**Metals, Alkaline Earth.** See metals, earth.

**Metals, Base.** Metals which lose their metallic character and are con-

verted into oxides when they are heated in contact with air or oxygen.

**Metals, Earth.** See metal, earth.

**Metals, Fusible.** Alloys which melt at low temperatures, viz.,

Composition.

Metal.	M.P.	Bi.	Pb.	Sn.	Cd.
Lipowitz'	60°	15	8	4	3
Rose's	94°	2	1	1	
Wood's	71°	4	2	1	1

**Metals, Heavy.** Metals of high specific gravity. Their sulphides are insoluble in water and are precipitated by ammonium sulphide.

**Metals, Light.** A term sometimes used to characterize metals of low specific gravity. Their sulphides are soluble in water.

**Metals, Noble.** Metals which are not oxidized on heating in air or oxygen, as gold, silver, platinum, etc.

**Metamer.** An isomer of like molar weight.

**Metamerism.** Isomeric with a compound of like molar weight.

**Metamerism.** Isomerism q.v. Formerly used to distinguish the isomerism of compounds of like molar weights from isomerism due to polymerization.

**Metathesis.** (Metathetical reaction.) A chemical reaction in which an element or radical in one compound changes places with another element or radical in another compound, e.g.  $\text{NaNO}_3 + \text{KCl} = \text{NaCl} + \text{KNO}_3$ .

**Meter.** A unit of linear measure (length) in the metric system, intended to be one ten-millionth part of the earth's quadrant from equator to pole. The meter is now an arbitrary unit.

1 meter = 3.28083 feet.  
 1 " = 1.093611 yards.  
 1 " = 39.37 inches.  
 1 foot = 0.3048 meter.

**Methane Series.** The paraffin hydrocarbons.

**Methanolysis.** Alcoholysis in which the alcohol split is methyl alcohol.

**Methenyl Group.** The trivalent group,  $\text{H.C} \equiv$ . Also called the methine group.

**Methide.** A metal-organic compound with methyl groups, as zinc methide  $\text{Zn}(\text{CH}_3)_2$ .

**Methine Group.** See methenyl group.

**Metho-.** A prefix used to indicate a methyl group attached to the middle atom of a side chain, as recommended by the Geneva commission.

**Methoxyl.** The univalent group  $\text{CH}_3\text{O}-$  analogous to hydroxyl and ethoxyl.

**Methyl.** (Methyl group.) The univalent radical  $\text{CH}_3-$  derived from methane.

**Methylate.** 1. To add a methyl group to or substitute methyl in a compound. 2. A metallic compound of methyl alcohol, as sodium methylate  $\text{CH}_3\text{ONa}$ .

**Methylene Group.** The divalent radical  $:\text{CH}_2$  derived from methane.

**-Metry.** A suffix which denotes the art of measuring, e.g. thermometry, the art of measuring temperatures; eudiometry, the art of measuring gases; acidimetry, the art of measuring the acidity of any system.

**Mho.** The unit of electrical conductance. The reciprocal ohm. A conductance of one mho per centimeter cube at a potential of one volt

per centimeter permits the passage of a current of one ampere per square centimeter.

**Micelle.** "Colloidal ion." An highly charged and hydrated colloidal aggregate. These micelles are supposed to occur in solutions of certain colloidal electrolytes, such as soaps, and to be responsible for some of the abnormalities exhibited by such solutions.

**Microampere.** An electrical unit equal to one-millionth ampere.

**Microchemical.** Pertaining to the processes and data of microchemistry.

**Microchemistry.** 1. Colloid chemistry. 2. Chemistry which involves the use of the microscope. It deals with microscopical processes in either living or dead material, such as the identification of crystals, the observing of reactions between minute quantities of material, etc.

**Microcoulomb.** An electrical unit. The millionth part of a coulomb.

**Microcrith.** The "weight" of the hydrogen atom, an obsolete standard for atomic weights. See crith.

**Microfarad.** The practical unit of electrical capacity equal to one millionth of a farad.

**Micromillimeter.** The micron.

**Micron.** ( $\mu$ ) A unit of linear measure used for minute lengths. It is equal to the thousandth part of a millimeter (0.001 mm.).

**Midrib.** (bot.) The main or central rib of a leaf.

**Mil.** The thousandth part of a liter. It is a shortened form of "milliliter" and is being generally adopted to replace the inaccurate term "cubic centimeter."



mol and  $\gamma$  = the surface tension, the molar surface energy is  $V^{2/3}\gamma$ . At the critical point the molar surface energy is zero. It decreases proportionately to increase of temperature and its temperature coefficient is the same for all homogeneous liquids.

**Molar Volume.** The volume occupied by a gram-molecule of any substance in vapor (reduced to 0° and 760 mm.). For all gases it is approximately equal to 22.4 liters. For ideal gases it is 22.412 liters.

**Molar Weight.** See molecular weight.

**Molecular.** Pertaining to or characteristic of molecules.

**Molecular Solution Volume.** The difference in volume between pure solvent and a solution which contains one mol of dissolved substance.

**Molecular Weight.** See weight, molecular.

**Molecule.** The smallest particle of any substance which can exist free and still exhibit all of the properties of the original compound. Molecules are composed of one or more atoms.

**Molecules, Inactive.** Molecules which do not react. Arrhenius assumed that a certain proportion of such molecules exist in cane sugar in order to explain the influence of temperature on the rate of inversion. He assumed that the larger portion of the sugar molecules is inactive and is converted into "active" sugar (capable of being inverted) by rise of temperature.

**Molecuics.** A name proposed for physical chemistry to avoid the ambiguity presented by the term physical.

**Molics.** A name suggested for the science of pure physics. It is derived from the phrase "molar forces."

**Moloxide.** The autoxidator. See autooxidation.

**Molugram.** A gram-molecule.

**Molugram-Liter.** The volume of one mol of a gas under standard conditions, i.e. about 22.4 liters.

**Molybdenous.** A salt of molybdenum in which that metal is divalent.

**Molybdenic.** A salt of molybdenum in which that metal is trivalent.

**Molybdenum.** Metallic element. Mo. At. Wt. 96. S. G. 8.6-9. S. heat 0.0657. M. P. 840°. Occurs as molybdenite ( $\text{MoS}_2$ ), and as wulfenite. Oxides,  $\text{Mo}_2\text{O}_3$ ,  $\text{MoO}_2$ ,  $\text{MoO}_3$ ,  $\text{Mo}_2\text{O}_5$ . Valence 2, 3, and 6. Molybdic acid,  $\text{H}_2\text{MoO}_4 \cdot 4\text{H}_2\text{O}$ .

**Molybdic.** Same as molybdenic.

**Mono-.** Same as mono-.

**Monacid.** A base which combines with but one molecule of univalent acid per molecule of base, as sodium hydroxide and strychnine.

**Monad.** 1. An element whose chief valence is one, as sodium or hydrogen. 2. An element which, among others, has a valence of one, as copper, gold, or mercury. (Obsoluscent.)

**Monamide.** An amide which contains but one amido group, as acetamide.

**Monamine.** An amine which contains but one amino group, as methyl amine.

**Mono-.** (Mon-) Prefixes which indicate "one" or unity of content of some physical or chemical property or quality.

**Monocotyledon.** (bot.) A plant which has but one cotyledon or seed leaf.

**Monoecious.** (bot.) A plant in which the stamens and pistils are found in separate flowers.

**Monogens.** Univalent elements which combine in but one proportion, as hydrogen, chlorine, or bromine.

**Monoses.** Hexoses q.v.

**Monotropy.** A form of allotropy in which one allotrope is perfectly unstable at all temperatures and pressures.

**Monte-Acid.** An apparatus used in pumping acids, e.g. an acid egg.

**Mordant.** A substance used in dyeing to fix or develop a color on the fibre. Salts of aluminium, chromium, iron, tin, antimony, copper, acids, and tannins are used as mordants.

**Mordant Dyes.** (Adjective dyes.) Dyes which are not adsorbed on the fibre until it has been treated with a mordant.

**Morphotropy.** In crystals the change in the ratio of the axes caused by changes in molecular structure such as substitution of certain radicals.

**-Morphous.** A term-element which indicates "form" or "shape" as in isomorphous, dimorphous, etc.

**Mucins.** The glycoproteins which occur in the secretions of the organism.

**Mucoids.** 1. Albumen glucosides or glycoproteins. 2. All nitrogenous

substances contained in an egg white which do not coagulate on heating.

**Multifid.** (bot.) Cleft into many lobes.

**Multirotation.** See mutarotation.

**Multivalent.** Having a valence of three or more.

**Muriate.** A chloride, i.e. a salt of muriatic (hydrochloric) acid. (obs.)

**Muriated.** Chlorinated.

**Muride.** An obsolete name for bromine.

**Mutarotation.** (Multirotation, bi-rotation.) A phenomenon shown by freshly prepared solutions of certain sugars in which a change in specific rotation occurs upon standing. Some sugars show a decrease (i. e. glucose, 50%) while others (maltose) show an increase of specific rotation. The change is not always in any special ratio.

**Mydriatic.** A compound which causes dilation of the pupil of the eye (mydriasis).

**Myotic.** A compound which causes contraction of the pupil of the eye (myosis).

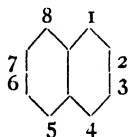
**Myria.** A metric prefix which indicates ten thousand, as myriameter.

**Myriad.** An indefinite, large number.

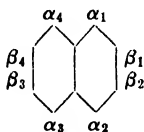
## N.

**N.** Symbol for nitrogen, normal, etc. Used to indicate combination with the nitrogen atom of organic compounds, e.g. in cases where combination may take place in other ways, as N-methyl, to indicate that it is the nitrogen atom and not one of the ring carbons which has been methylated, or N-benzoyl, to indicate that the nitrogen atom and not an hydroxyl has been acylated.

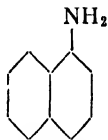
**Naphthalene Compounds, Nomenclature of.** The positions in the naphthalene ring are designated



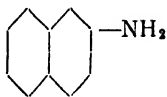
or



Two monosubstitution products are possible according to whether the substituent is adjacent to the central complex or is separated from it by a .CH. group, viz.,



$\alpha$ -naphthylamine



$\beta$ -naphthylamine.

The disubstitution products are named as follows; 1-2 ortho, 1-3 meta, 1-4

para, 1-5 ana, 1-6 epi, 1-7 kata, 1-8 peri, 2-3 not named, 2-6 amphi, 2-7 pros. Polysubstitution products are designated by numbers. Substituents in the same ring are termed isonuclear, those in different rings heteronuclear.

**Naphthenes.** (Cycloparaffines.) Saturated cyclic hydrocarbons of the general formula  $C_nH_{2n}$ . They occur in Galician and Russian petroleum.

**Naphtho-.** A prefix used to designate naphthalene derivatives which are isologues of benzene derivatives as, naphthophenols, naphthoquinone, naphthobenzyl alcohol.

**Naphthols.** Phenolic derivatives of naphthalene. Two isomeric monohydroxyl naphthalenes are possible, the  $\alpha$  and  $\beta$  naphthols.

**Naphthyl.** The radical  $C_{10}H_7$ — derived from naphthalene as phenyl is derived from benzene.

**Narcotic.** A drug which depresses the psychic area of the brain causing complete insensibility.

**Nascent.** A term used to designate an element just liberated from combination. Some elements show much greater activity in this nascent state than they show in their ordinary conditions. Nascent hydrogen will reduce compounds which are not greatly affected by ordinary hydrogen gas.

**Natrium.** Latin name for sodium.

**Nebulium.** (Nu.) An unknown element assumed to exist in certain nebulae. At. Wt. 1.31 (calc).

**Nectary.** (bot.) A plant organ which secretes nectar.

**Negative Catalysis.** (Catalytic retardation.) The retardation of the velocity of a reaction by a catalyst, e.g. alcohol markedly retards the oxidation of sulphites by free oxygen.

**Neo-** A prefix which indicates "new" or "recent" as neodymium, neoparaffins.

**Neodymium.** Metallic element. Nd. At. Wt. 144.3. S. G. 6.9563. M. P. 840°. Valence 3. Occurs in cerite and other rare minerals. Oxides  $\text{Nd}_2\text{O}_3$ ,  $\text{NdO}_2$ .

**Neon.** Gaseous element. Ne. At. Wt. 20.2. S. G. 9.96 ( $H = 1$ ). M. P.  $-253^\circ$ . B. P.  $-243^\circ$ . Forms no known compounds. 10,000 vols of air contain about 0.15 vol of neon.

**Neptunium.** Announced as an element by Hermann; probably a mixture of columbium and tantalum.

**Neutral.** 1. Neither acid nor alkaline in reaction. 2. According to the ionization hypothesis a concentration of hydrogen ions equal to  $1 \times 10^{-7}$ . (The figure varies a little according to the temperature and the method of determining the degree of ionization of water.) Hydrogen ion concentrations greater than this figure confer acid properties; lower concentrations occur in alkaline systems.

**Neutral Elements.** The rare gases of the atmosphere.

**Neutrality.** The condition of being neutral.

**Neutralization.** The process of rendering a system neutral.

**Neutralization, Heat of.** The heat change which occurs when a dilute solution of one mol of base (or acid) in exactly neutralized by a dilute

solution of an acid (or base). With fully dissociated compounds the heat evolved is nearly 57. KJ. or the heat of formation of water from hydroxyl and hydrogen ions. When precipitation occurs during the neutralization the heat of solution of the compound affects the observed heat of neutralization. When weak acids are used the observed change is the sum of the heat of ionization of the acid and the heat of neutralization.

**Neutralize.** To bring into a neutral state.

**Neutralizer.** Any agent capable of adjusting the hydrogen ion concentration of a system to about  $1 \times 10^{-7}$ .

**Neutral Point.** The condition of neutrality.

**Neutral Salt Effect.** The diminution of the ionization of a weak acid or base on the addition of a neutral salt which contains one of the ions of the ionized substance, e.g. the use of sodium acetate in analysis.

**Neutron.** An hypothetical, electrically neutral, massless molecule assumed to be a compound of positive and negative electricity for theoretical reasons.

**Nickel.** Metallic element. Ni. At. Wt. 58.68. S. G. 8.6 to 8.9. S. heat 0.1084. M. P.  $1435^\circ$ . Occurs in niccolite. Valence 2 and 3. Oxides  $\text{NiO}$ ,  $\text{Ni}_2\text{O}_3$ ,  $\text{Ni}_3\text{O}_4$ .

**Nickelic.** Compounds of nickel in which that metal is trivalent.

**Nickelous.** Compounds of nickel in which that metal is divalent.

**Niobic.** A salt of columbium.

**Niobium.** See columbium.

**Niton.** Gaseous element. Nt. At. Wt. 222.4. Occurs in radium emanation. See emanation.



**Nitramines.** (Nitroamines.) Nitroderivatives of the amines characterized by the group  $R-NH-NO_2$ .

**Nitrate.** 1. A salt of nitric acid as, potassium nitrate,  $KNO_3$ . All normal nitrates are soluble in water. 2. To bring about the addition to or substitution in carbon compounds of the group  $-NO_2$ , (the nitro group). Such compounds are said to be nitrated, and the process is known as nitration.

**Nitrated.** See nitrate.

**Nitration.** See nitrate.

**Nitric Acid.** One of the nitrogen acids,  $HNO_3$ .

**Nitridation.** Combining with nitrogen to form a nitride.

**Nitrides.** Compounds of nitrogen with the metals, as  $Mg_3N_2$ ,  $Li_3N$ . Salts of azoimide  $HN_3$  (as  $LiN_3$ ) are a special class of nitrides.

**Nitrification.** Nitration.

**Nitrify.** To nitrate.

**Nitrifying.** Causing combination with nitrogen, especially certain microorganisms which fix the atmospheric nitrogen.

**Nitriles.** (Alkyl cyanides, acid nitriles.) Organic nitrogen compounds which may be regarded as derived from hydrocyanic acid ( $H-C\equiv N$ ) by substitution of alkyl or aryl for hydrogen, e.g. ethyl cyanide,  $C_2H_5-CN$ . On hydrolysis the nitriles yield acids and are sometimes termed the acid nitriles on this account.

**Nitriles, Acid.** See nitriles.

**Nitrile Bases.** Tertiary amines and amides so called to distinguish them from the alkyl cyanides or acid nitriles.

**Nitrine.** Allotropic form of nitrogen,  $N_3$ , produced in the nascent state

under suitable conditions and at once breaking up into ordinary nitrogen.

**Nitrites.** Salts of nitrous acid  $HNO_2$ , as sodium nitrite,  $NaNO_2$ . Most metallic nitrites are soluble in water. Alkyl nitrites are isomeric with but not identical with the nitro-paraffins.

$C_2H_5NO_2$	$C_2H_5.O.N : O$ .
nitroethane.	ethyl nitrite.

**Nitro Group.** The univalent group  $-NO_2$ . The prefix "nitro" indicates content of this group, e.g. nitrobenzene,  $C_6H_5NO_2$ .

**Nitroamines.** Nitramines, q.v.

**Nitrogen.** Gaseous element. N. At. Wt. 14.008. Mol. Wt. 28.016. S. G. 0.96737. (air = 1). S. heat 0.2438. M. P.  $-213^\circ$ . B. P.  $-195.5^\circ$ . Valence 3 and 5. Occurrence, air, of which it constitutes about 80%. Oxides, nitrous oxide,  $N_2O$ ; nitric oxide,  $NO$ ; nitrogen trioxide,  $N_2O_3$ ; nitrogen peroxide,  $NO_2$ ; nitrogen pentoxide,  $N_2O_5$ ; to which may be added nitrogen tetroxide  $N_2O_4$ . Acids, hydrazoic acid,  $HN_3$ ; hyponitrous,  $H_2N_2O_2$ ; nitrohydroxylamic,  $H_2N_2O_3$ ; nitrous,  $HNO_2$ ; nitric,  $HNO_3$ .

**Nitrogenize.** To combine or impregnate with nitrogen or nitrogenous compounds.

**Nitrogenous.** Pertaining to or containing nitrogen. Proteins are nitrogenous foodstuffs.

**Nitro-Hydrochloric Acid.** See aqua regia.

**Nitrolime.** (Nitrolim.) Calcium cyanamide,  $CaCN_2$ .

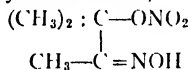
**Nitrometer.** An apparatus in which nitrogen (or other gas) may be collected and measured. A special form of eudiometer. There are many forms of nitrometers. Some are arranged so that a nitrogen evolving reaction

may be conducted within the apparatus and the evolved nitrogen directly measured.

**Nitrophenol.** An organic compound which contains both nitro and phenolic hydroxyl groups, as p-nitrophenol.

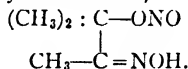


**Nitrosates.** Organic nitrogen compounds which may be regarded as isonitroso derivatives of nitric esters, e.g. isoamylene nitrosate,



**Nitrose.** Nitrous.

**Nitrosites.** Organic nitrogen compounds which may be regarded as isonitroso derivatives of nitrous esters, e.g. isoamylene nitrosite,



**Nitroso Compounds.** Organic compounds which contain the nitroso group,  $-\text{N} : \text{O}$ , as nitroso benzene,  $\text{C}_6\text{H}_5-\text{NO}$ .

**Nitrosyl.** The univalent radical  $-\text{N} : \text{O}$  in inorganic compounds, e.g. nitrosyl chloride,  $\text{NOCl}$ . Cf. nitroso.

**Nitrosyllic.** Pertaining to or containing nitrosyl.

**Nitrous.** A compound which contains trivalent nitrogen, as nitrous acid.

**Nitroxyl.** The univalent radical  $-\text{NO}_2$  when it occurs in inorganic compounds, as nitroxylpyrosulphuric acid,  $\text{O}(\text{SO}_2.\text{O}.\text{NO}_2)_2$ . Cf. nitro.

**Nitry.** Nitrous.

**Nitryl.** The nitro group.

**Node.** (bot.) A place on the stem of a plant where a leaf is usually borne.

**Nomenclature, Geneva.** See carbon compounds, nomenclature of.

**Non-Acid.** Basic, metallic. Any radical, atom, or molecule destitute of acid properties. (obs.)

**Non-Metals.** The elements usually classed outside of the metals. There is no sharp line of demarcation between the two classes. Non-metals in general are acid-forming, uniting with hydrogen more readily than the metals, do not conduct electricity as well, and transmit light better than the metals. Half of the twenty non-metals are gases. In ionized compounds the anions usually consist of the non-metallic portion of the molecule, hydrogen being an exception.

**Non-Metallic.** Not of metallic nature.

**Norium.** Metallic element supposed to have been discovered in zircon. It has not been confirmed.

**Nuclei, Condensed.** When two or more nuclei are linked together so that each nucleus has two carbon atoms in common with another nucleus the condition is termed condensed nuclei. If there are but two nuclei so condensed the complex is known as twin nuclei. E.g. naphthalene contains a twin nuclei complex and anthracene a condensed nucleus.

**Nuclei, Twin.** See nuclei, condensed.

**Nucleoproteins.** See proteins.

**Nucleus.** 1. The ring or characteristic radical in a compound which persists as a unit through a series of chemical changes. 2. Any material agent capable of serving as a base upon which a new phase may form in cases of metastable equilibrium, as gas bubbles, dust, ions, crystals, etc. See nuclei, condensed.

## O.

**Obovoid.** (bot.) Having the form of an inverted egg.

**Occlusion.** A condition of uniform molecular adhesion between a precipitate and a soluble substance, or between a gas and a metal, of such a nature that it is very difficult to separate the occluded substance by washing or other simple mechanical process. Occlusion in precipitates depends upon the distribution of a substance between solvent and solid and is, probably, due to adsorption.

**Octad.** An element which is octavalent.

**Octoses.** Carbohydrates which contain a chain of eight carbon atoms.

**Official.** Literally "of the shops." Applied to plants which are used in medicine or in the arts. All plants recognized by the United States or other Pharmacopocia or the National Formulary are termed "official."

**Ogdohedral.** Hemihedral or tetrahedral crystals.

**Ohm.** An electrical unit of resistance. The international ohm is the resistance offered to an unvarying current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area and of a length of 106.300 centimeters.

**Oil.** An unctuous liquid which is immiscible with water. Oils are usually combustible. They are classified as animal, vegetable, or mineral according to their origin; as volatile or fixed and as drying or non-drying according

to their physical and chemical properties.

**Olefiant Gas.** Ethylene, so called because it combines with chlorine to produce a heavy oily dichloride,  $C_2H_4Cl_2$ .

**Olefin.** A member of the olefin series of unsaturated aliphatic hydrocarbons of the general formula  $C_nH_{2n}$ , e.g. ethene,  $C_2H_4$ . Olefins are named from the corresponding paraffin hydrocarbons by adding the suffix "ylene" to the stem or (Geneva plan) by changing the suffix "ane" to "ene." E.g. from ethane we derive the names ethylene and ethene.

**Oleograph.** The shape assumed by a drop of oil in contact with a liquid system with which it is immiscible. (obs.)

**Oleometer.** (Elaionometer.) An hydrometer for oils.

**Oleoptene.** An eleoptene, q.v.

**Oleoresins.** A class of plant products which consist of mixtures of resins and volatile oils, e.g. turpentine, oleoresins of aspidium, of capsicum, etc.

**-on.** A suffix indicating ketone structure, e.g. propanon.

**-one.** 1. The characteristic suffix for a series of unsaturated aliphatic hydrocarbons. 2. A suffix used to indicate ketone structure. The suffix -on is preferred for this purpose.

**Opsonic Index.** The ratio between the number of bacteria devoured by

the leucocytes in a certain sample of blood and the number devoured in a normal sample which is taken as 1.

**Opsonins.** Substances produced by the body cells which increase the phagocytic activity of the leucocytes. They resemble ferments, are thermostable being destroyed at 60° C., and are specific for a given organism.

**Optical Superposition, Principal of.** Van't Hoff's assumption that the rotation of a compound composed of two oppositely optically active radicals is the algebraic sum of the separate rotations of each radical. It does not hold in all cases.

**Optically Void Liquids.** Liquids which do not exhibit the Tyndall effect, e.g. liquids which contain no suspended solids.

**Optimum Temperature.** The temperature above which enzymes are destroyed.

**Organic.** 1. Pertaining to or derived from a carbon compound. 2. A product of a biochemical process.

**Organized Ferments.** (Intracellular ferments.) Ferments characterized by connection with living cells, as yeast. It was formerly believed that there is a specific difference between organized and unorganized ferments. This is known to be untrue though certain fermentations are not known to take place in the absence of living matter.

**Organogen.** Any one of the four elements, carbon, hydrogen, nitrogen, and oxygen, and, by extension, sulphur, phosphorus, and chlorine, characteristic of organic products.

**Organoleptic.** A property which may be perceived by a sense organ, as taste, odor, or color.

**Organosols.** Colloidal solutions in which the continuous phase is an

organic solvent such as alcohol, benzene, ether, amyl alcohol, pentane, etc.

**Orientation.** The positions assumed by substituents in relation to the configuration of the parent substance and to each other is spoken of as the orientation of the substituents.

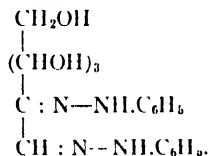
**Ortho-.** 1. A prefix used to distinguish isomers or related compounds. 2. The cyclic derivative which has two substituents in adjacent positions. See benzene compounds, nomenclature of.

**Orthoquinoid Group.** The atomic structure

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an important chromophore.

**Osazones.** Compounds of the sugars and phenylhydrazine. They are often crystalline and sparingly soluble and serve to separate and identify the individual sugars, e.g. glucosazone,



**Oscillating Double Bond.** See tautomerism and phastotropy.

**-ose.** A suffix which denotes that the compound is a carbohydrate, e.g. dextrose, saccharose, amylose.

**Osmic.** A salt of osmium in which the metal is tetravalent.

**Osmious.** A salt of osmium in which the metal is trivalent.

**Osmium.** Metallic element. Os. At. Wt. 190.9. S. G. 22.48. S. heat, 0.03113. M. P. 2500°. Occurs in platinum ores. Valence, 2, 3, and 4.

Oxides,  $\text{OsO}$ ,  $\text{Os}_2\text{O}_3$ ,  $\text{OsO}_2$ ,  $\text{OsO}_4$ .  
Osmic acid,  $\text{H}_2\text{OsO}_4$ .

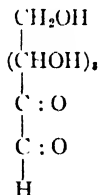
**Osmocyanic.** Pertaining to the complex of osmium and cyanogen, as osmocyanic acid,  $\text{H}_4\text{Os}(\text{CN})_6$ .

**Osmose.** } See osmotic pressure.  
**Osmosis.** }

**Osmotic Pressure.** The pressure developed by the attraction of a solution for more solvent. If a partition permeable to the solvent but not to the solute be placed between a solution and pure solvent, solvent will pass through the partition into the solution. The level of the latter will rise (endosmosis) and the level of the solvent will fall (exosmosis). The process will continue until the difference in level is great enough to exert a back pressure equal to the osmotic pressure. The process is known as osmose or osmosis.

**Osmyl.** The radical  $\text{OsO}_2$ .

**Osones.** Ketone-aldehyde derivatives of the sugars prepared by the hydrolysis of the osazones, e.g. glucosone,



**Ounce.** (oz.) A unit of mass in the avoirdupois, apothecaries', and troy systems. The apothecaries' and troy ounces are identical.

1 av. ounce = 28.3495 grams.  
1 " " = 437.5 grains.  
1 troy ounce = 31.1035 grams.  
1 apoth. ounce = 480 grains.

**Fluid Ounce.** (Fluidounce.) A unit of liquid measure in the English system.

1 floz. = 28.39661 mls.

1 mil = 0.03527 ounce.

1 U. S. liquid ounce = 29.574 mls.

**-ous.** A suffix used to denote a lower state of valence (or oxidation) as mercurous, ferrous, etc. Salts of acids which end in -ous are terminated by the suffix -ite, as sulphurous—sulphite, chlorous—chlorite.

**Ovary.** (bot.) That part of a pistil which contains the ovules or rudimentary seeds.

**Ovate.** Egg-shaped.

**Overcooling.** Undercooling.

**Overheating.** Raising the temperature of a liquid above its boiling point. Drops of water in oil may be overheated to  $140^\circ$  at atmospheric pressure without vaporizing.

**Oversaturated.** Supersaturated.

**Over Voltage.** Super potential. See excess voltage.

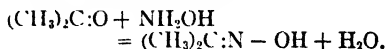
**Oxacid.** Oxyacid.

**Oxidases.** Enzymes which catalyze the oxidation of many substances by free oxygen, e.g. tyrosinase, laccase, uricolase. Cf. peroxidase.

**Oxidation.** Combination with oxygen. Increasing valence by a chemical process. The correlative of reduction.

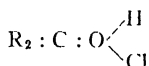
**Oxidation, Fractional.** The separation of the constituents of a mixture by oxidizing under such conditions that only a part of the constituents are affected. Cf. combustion, fractional.

**Oximes.** Compounds which result from the interaction of aldehydes, ketones, and other carbonyl-containing substances with hydroxylamine. E.g., acetone yields acetoxime;



**Oxo-**. A prefix suggested by Kekulé to distinguish oxygen which is doubly linked to carbon, as in the carbonyl group. Acetone would be termed 2-oxopropane; propionic aldehyde, 1-oxopropane.

**Oxonium Compounds.** (Oxonium salts.) Compounds in which oxygen has a valence of four, known only in solution. Carbonyl containing compounds sometimes combine with mineral acids in solution to form oxonium salts, e.g.



See halochromism.

**Oxy-.** A prefix which indicates 1. content of oxygen, 2. a derivative which differs from the parent compound by a greater content of oxygen.

**Oxyacid.** An acid which contains oxygen, as chloric. So called to distinguish them from the hydric acids, i.e. compounds of the elements with hydrogen alone, as hydrochloric acid

**Oxygen.** Gaseous element. O.  
At. Wt. 16 (standard). Mol. Wt. 32.  
S. G. 1.19535 (air = 1). S. heat  
0.2175. M. P. below  $-233^{\circ}$ . B. P.  
 $-182.5^{\circ}$ . Occurs in air (about 20%),  
in oxides, etc. Valence 2. (Ozone,  
O<sub>3</sub>, allotropic form of oxygen, S. G.  
1.658 (air = 1). Mol. Wt. 48. De-  
composes at  $270^{\circ}$ .)

**Oxygenation.** 1. Impregnation with oxygen. 2. Oxidation.

**Oxygenator.** An apparatus for impregnating a liquid with oxygen.

**Oxygenic.** Pertaining to or containing oxygen.

**Oxygenate.** (Oxygenize.) 1. To impregnate with oxygen. 2. To oxidize.

**Oxygenium.** Latinized form of oxygen.

**Oxygenizable.**    **Oxidizable.**

**Oxy-Hydrogen.** Employing or produced by a mixture of oxygen and hydrogen, as the oxy-hydrogen blow-pipe, or oxy-hydrogen light.

**Oxyntic.** (physiol.) An organ which produces acid.

**Oxy-Salt.** A salt of an oxyacid, e.g. sodium sulphate.

**Oxysulphide.** (Oxysulphuret.) A compound which contains oxygen and sulphur. (Obs.)

**Oxysulphion.** Daniell's term for the sulphate radical,  $\text{SO}_4$ . (Obs.)

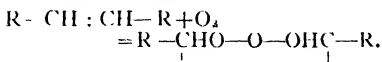
**Oxysulphonide.** Daniell's term for sulphate. (Obs.)

**Oxysulphuret.** See oxysulphide.

**Ozonation.** Impregnating or combining with ozone.

**Ozone.** Allotropic form of oxygen.  
See oxygen.

**Ozonide.** A compound of ozone with certain unsaturated organic compounds produced by direct addition to the double bond, e.g.



**Ozonize.** To impregnate with ozone as in a process for purifying water.

## P.

**Pairing.** Löwig's term for the indifferent radical in a compound of two radicals where the second, the "active molecule," determines the "combining capacity." (Obs.)

**Palladic.** A salt of palladium in which the metal is quadrivalent.

**Palladium.** Metallic element. Pd. At. Wt. 106.7. S. G. 11.4-11.9. S. heat 0.0592. Valence 2 and 4. M. P. 1546°. Occurs in platinum ores. Oxides PdO, Pd<sub>2</sub>O.

**Palladious.** A salt of palladium in which the metal is bivalent.

**Palmete.** (bot.) A leaf which is radiately divided or lobed.

**Pantochromism.** The phenomenon of existing in two or more differently colored varieties exhibited by certain salts. Ex. salts of diphenylvioluric acid exhibit pantochromism.

**Para-.** A prefix used to distinguish between isomers or nearly related compounds. Specifically, in organic chemistry the derivatives of cyclic nuclei which contain substituents in the 1-4 position. See benzene compounds, nomenclature of.

**Paraffin.** 1. A member of the paraffin series. 2. An homologous series of saturated aliphatic hydrocarbons of the general formula C<sub>n</sub>H<sub>2n+2</sub>. The first member is methane, CH<sub>4</sub>. The lower members of the paraffin series are gases, those which contain 5 to 17 carbon atoms are liquids at 20°, and the higher members are colorless solids. Most of the paraffins occur in petroleum. They

are designated by the suffix "ane" and all but the first four members of the series are named from the Greek numerals corresponding to their straight-chain carbon content.

**Parallelosterism.** A relationship between analogous and isomorphous groups in which similar differences in chemical composition occur with similar differences in molecular volume. Thus the difference in the molar volumes of KCl and KBr is 6.9, between NaCl and NaBr, 6.7, and between AgCl and AgBr, 6.2.

**Para-Magnetic.** (Magnetic.) Substances which offer less resistance to the magnetic flux than does air, e.g. iron, cobalt, and nickel. Substances which offer greater resistance than air are termed diamagnetic. Ferromagnetic substances are those of high magnetic properties, as iron.

**Paraquinoid Group or Structure.** See quinoid.

**Parasemidine.** See semidine rearrangement.

**Parasitic.** Growing on and deriving nourishment from another organism.

**Paratartarics.** Racemic forms (Pasteur).

**Partial Pressure.** The pressure exerted by each single component in a mixture of gases or its portion of the total pressure. See law of Dalton.

**Partition Coefficient.** See coefficient distribution and law, distribution.

**Passive State.** (Passivity.) 1. Comparatively inert. 2. A condition

in which a substance does not exhibit its usual chemical activity, as passive iron which is not acted upon by nitric acid.

**Passivity.** See passive state.

**Pectise.** (Pektise.) To gelate or gelatinize. See gel.

**Pectization.** (Pektization.) Gelation or gelatinization. See gel.

**Penta-Basic.** An acid capable of neutralizing five equivalents of mono-acid base.

**Pentacid.** A base capable of neutralizing five equivalents of mono-basic acid.

**Pentad.** An element which is pentavalent, e.g. nitrogen, phosphorus, or arsenic.

**Pentatomic.** Containing five hydroxyl groups, as glucose.

**Pentavalent.** Having a valence of five, e.g. able to combine with five equivalents of hydrogen. A pentad.

**Pentites.** Pentatomic alcohols, as l-arabite,  $C_5H_7(OH)_6$ .

**Pentosanes.** Gums which, on hydrolysis, yield pentoses, as cherry gum which yields l-arabinose. They are classed as polysaccharoses.

**Pentose.** A sugar which contains five carbon atoms, as arabinose  $C_5H_{10}O_5(OH)_4$ .

**Pentoxide.** An oxide whose molecule contains five atoms of oxygen, as phosphorus pentoxide,  $P_2O_5$ .

**Peptise.** (Peptization.) The reverse of gelate. The liquefaction of a colloidal gel to form a sol.

**Peptones.** A class of protein derivatives formed from albumins by hydrolysis in the presence of pepsin. They are completely soluble in water and are not coagulated by heat.

**Per-** A prefix indicating "above" or "beyond." Used to designate a compound in which some element exhibits unusually high valence, as perchlorate.

**Percarbide.** A carbide which contains more carbon than is necessary to saturate the highest valence of the metal with which it is combined.

**Percarburetted.** Combined with a relatively large amount of carbon. (Obs.)

**Perchloride.** A chloride which contains a larger proportion of chlorine than any other chloride of the same element or radical.

**Percolate.** Literally, to strain through. To extract by percolation.

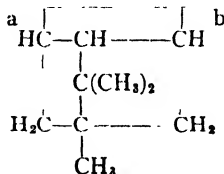
**Percolation.** A process for the continuous extraction of soluble matter from its admixture with insoluble material by a suitable solvent, conducted in such a way that the solvent travels through the mass to be extracted, from one surface of which the partially saturated solution is removed while fresh solvent is admitted at the opposite surface.

**Perennial.** (bot.) A plant which persists more than two years.

**Perfoliate.** (bot.) A leaf through which the stem apparently passes.

**Pericarp.** (bot.) A matured ovary.

**Pericyclo Position.** A term proposed by Bredig for the position (or linkage) a-b in R-hexane derivatives, viz.,





**Period of Half-Decay.** The time required for one-half of a radioactive element to change into its next stage of development.

Radium, 2,000 years

↓  
Niton, 3.7 days

↓  
Radium A, 3 minutes.

Uranium,  $5 \times 10^9$  years.

Thorium,  $3 \times 10^{10}$  years.

**Periodicity.** The variation of physical and chemical properties of an element in relation to its position in the periodic table.

**Periodic Law.** See law, periodic.

**Periodic Table.** (Periodic system. Periodic classification.) Any one of a number of arrangements of the elements in the order of their atomic weights designed to show that the properties of the elements are periodic functions of their atomic weights. See law, periodic.

**Permanent Gases.** An historic classification that included those gases which are very difficult to liquefy and which were thought to be non-liquefiable. The distinction has vanished since all the gases have been liquefied.

**Perissads.** See artiads.

**Peroxidases.** A class of vegetable enzymes which activate hydrogen peroxide, and probably other peroxides, and catalyze oxidation reactions which do not proceed with appreciable velocity in their absence.

**Peroxide.** An oxide which contains more oxygen than the valence of the associated element demands for saturation, especially where the oxygen is linked  $R-O-O-R$ , as in hydrogen peroxide and in the organic peroxides.

**Peroxidize.** To oxidize to the highest degree so as to form a peroxide.

**Peroxidation.** See peroxidize.

**Persulphates.** Salts of persulphuric acid,  $H_2S_2O_8$ .

**Persulphide.** A sulphide which contains a larger proportion of sulphur than is necessary to satisfy the highest valence of the associated element, as  $FeS_2$ .

**Petal.** (bot.) A division of a corolla.

**Petiole.** (bot.) The stalk of a leaf.

**Phagocytes.** Cells which swallow or engulf foreign substances such as bacteria. They are divided into two classes, the "fixed" phagocytes which are cells of the connective tissue and endothelium, and "free" phagocytes. Not synonymous with leucocytes. The engulfing action is termed "phagocytosis."

**Phagocytosis.** See phagocytes.

**Pharmacodynamics.** The science which treats of the actions and relations of drugs within the organism.

**Pharmacopoeia.** An authoritative list of drugs and medicinal compounds with a description of each, tests for its identity and purity, and its average dose. Directions for compounding all mixtures contained in the list are also included. Substances listed in the pharmacopoeia are termed "official." The United States Pharmacopoeia is revised every ten years.

**Pharmacopoeial.** Pertaining to the pharmacopoeia. Conforming to the requirements of the pharmacopoeia.

**Pharmaceutic.** Relating to the art of pharmacy.

**Pharmacy.** The art of selecting, preparing, and compounding medicinal agents.

**Phase.** A homogeneous aggregation of material which is physically distinct, as a liquid, a solution, or a gas. Solid matter contains as many phases as there are chemical individuals present. The term phase does not refer to any specific quantity of substance.

**Phase Rule, The.** A mathematical expression which shows the conditions of equilibrium in a system as a relationship between the number of phases, the number of components, and the degrees of freedom possible under the given conditions. If  $C$  represents the number of components,  $P$ , the number of phases, and  $F$ , the degrees of freedom, then  $C + 2 - P = F$ .

**Phasines.** A group of nitrogenous substances found in seeds, barks, and probably other plant tissues, which agglutinate red blood corpuscles although most of the phasines are non-toxic. They are found in beans (*Phaseolus vulgaris*) whence the name phasine. They act like strong bases and can be recovered from the agglutinate with dilute HCl. Phasines are digested and detoxicated in the intestinal tract; they lose their agglutinating powers on heating.

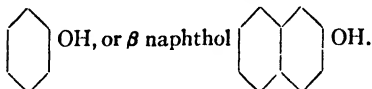
**Phasotropy.** (Virtual tautomerism.) A phenomenon shown by certain diazoamino compounds, amidines, and formazyl derivatives in which isomerism occurs through "oscillation" of a hydrogen atom and a double bond between nitrogen atoms, viz.,



where R and R' are univalent radicals.

**Phenol.** An hydroxyl derivative of a carbocyclic compound in which the

hydroxyl is directly united to a ring carbon atom (distinction from alcohols). E.g. carbolic acid, "phenol,"



Phenols are named from the parent hydrocarbon, as benzo-phenol, or by adding the prefixes "oxy-," "dioxy-," etc., to the hydrocarbon, as oxybenzene, dioxybenzene, etc. The common names of the phenols should terminate in "ol" as pyrogallol, resorcinol. Phenols are termed monohydric, dihydric, trihydric, etc., and polyhydric, according as they contain one, two, three, etc., or many hydroxyl groups, as m-dioxybenzene (resorcinol) a dihydric phenol, or trioxybenzene (pyrogallol) a trihydric phenol.

**Phenolates.** Compounds of the phenols with the metals in which the hydroxyl hydrogen is replaced by univalent metal or its equivalent, as  $\text{C}_6\text{H}_5\text{ONa}$ , sodium phenolate. The phenolates are usually soluble in water.

**Phenyl.** The univalent carbocyclic group  $\text{C}_6\text{H}_5-$  derived from benzene.

**Phenylene.** The divalent carbocyclic group  $\text{C}_6\text{H}_4=$ , i.e. benzene substituted in two positions yields o-, m-, p-, phenylene compounds.

**Phlogisticated Air.** Priestley's term for air that has been deprived of its oxygen, as by burning a candle in it.

**Phlogistic Theory.** See phlogiston.

**Phlogiston.** A name given by Stahl to an hypothetical "combustible principle" which was considered to be a component of all combustible substances and which conferred combustible properties upon them. This component was assumed to escape during combustion so that combustible substances were postulated as com-

pounds of phlogiston and what we now call their oxidation products. E.g. sulphur was assumed to be a compound of phlogiston and sulphur dioxide. The researches of Lavoisier on combustion overthrew the phlogiston theory.

**Phosphate.** A salt of phosphoric acid,  $H_3PO_4$ . Phosphoric acid forms three series of salts according to the number of hydrogen atoms replaced.

**Phosphide.** A salt of phosphine produced by replacing its hydrogen by a metal, as calcium phosphide,  $Ca_3P_2$ .

**Phosphonic.** See phosphonium.

**Phosphonium Compounds.** Salts of phosphine,  $PH_3$ . They are analogous to ammonium compounds. E.g.  $PH_4Cl$ ,  $PH_4Br$ .

**Phosphoproteins.** See proteins.

**Phosphoric.** Phosphorus compounds in which that element has a valence of five.

**Phosphorous.** Compounds of phosphorus in which that element is trivalent.

**Phosphorus.** Non-metallic element. P. At. Wt. 31.04. Mol. Wt. 124.16. Yellow P: S. G. 1.8232. S. heat 0.202. M. P. 44.2°. B. P. 290°. Red P: S. G. 2.296. S. heat 0.1829. M. P. 350°. A third modification, black P has also been described. Phosphorus occurs in phosphorite, apatite, vivianite, etc. Valence 3 and 5. Oxides,  $P_4O_6$ ,  $P_2O_4$ ,  $P_4O_{10}$ . Acids, hypophosphorus,  $H_3PO_2$ , hypophosphoric,  $H_4P_2O_6$ , pyrophosphoric,  $H_4P_2O_7$ , phosphorus,  $H_3PO_3$ , phosphoric,  $H_3PO_4$ , metaphosphoric,  $HPO_3$ .

**Phosphoryl.** The trivalent radical  $:P:O$ , as in phosphoryl bromide  $POBr_2$ .

**Phosphuretted.** Combined with phosphorus, especially "phosphuretted hydrogen" or phosphine,  $PH_3$ .

**Photochemistry.** That branch of chemistry which studies the chemical effects produced by radiant energy.

**Photoisomeric Change.** The conversion of one isomer into another due to the action of light, e.g. antinitrobenzaldehyde changes, when exposed to light, into the more stable syn form.

**Photolytic.** A reaction in which a substance is decomposed or split by radiant energy.

**Photopolymerization.** The polymerization of a substance when it is exposed to light, e.g. anthracene to dianthracene.

**Photostable.** Not altered upon exposure to light.

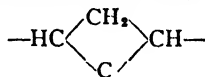
**Phototropism.** A reversible isomeric change in solid substances due to the influence of light energy and accompanied by a color change.

**Phthaleins.** Derivatives of a phthalide which contain two phenol residues, as phenolphthalein, resorcinphthalein (fluorescein).

**Physicochemical.** Pertaining to physical chemistry, see chemistry, physical.

**Phytosterolin.** A glucoside of a phytosterol, as ipuranol.

**Picean Ring.** A four membered ring which exists in certain terpenes, viz.,



**Piezo-Electricity.** Electricity produced by pressure (elastic deformation). The phenomenon is observed in certain crystals, ex. tour-

maline, mica, calcite, and quartz, which become electrically charged when subjected to pressure. One end of the crystal becomes positively charged and the other negatively charged.

**Piezometer.** An instrument for determining the compressibility of various substances particularly at very high pressures.

**Pinnate.** (bot.) A compound leaf in which the leaflets are arranged about a common petiole.

**Pistil.** (bot.) The seed-bearing organ of a flower. It consists of ovary, stigma, and style.

**Pistillate.** (bot.) Provided with pistils but not with stamens.

**Place Isomerism.** See isomerism, place.

**Plane Symmetric Configuration.** The malenoid form. See isomerism, geometric.

**Plasmolysis.** Abstraction of water from cells by bathing them in hypertonic solutions of salts, e.g. employing osmotic pressure to concentrate the cell sap. It is evident that, if the osmotic pressure of the cell is known, plasmolysis offers a means of approximately determining the osmotic pressure of "unknown" solutions.

**Platinic.** Salts of platinum in which the metal is quadrivalent.

**Platinode.** A cathode. (Obs.)

**Platinous.** Salts of platinum in which the metal is divalent.

**Platinum.** Metallic element. Pt. At. Wt. 195.2. S. G. 21.48. S. heat 0.0323. M. P. 1753°. Valence 2 and 4. Occurs native and in sperrylite. Oxides PtO, PtO<sub>2</sub>.

**Platize.** To coat, plate, or combine with platinum. To platinize.

**Platosammines.** Ammonium compounds of platinum of the general formula, X<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>Pt, in which X represents an univalent acid radical.

**Pleomorphism.** The property of crystallizing in two or more forms. The term includes dimorphism and trimorphism. Cf. polymorphism.

**Plumbic.** Compounds of lead, especially those in which the metal is quadrivalent.

**Plumbous.** Lead compounds, especially those in which lead is divalent.

**Plumbum.** Latin name of lead.

**Point, Liquefaction.** 1. Melting point. 2. The temperature and pressure at which a gas condenses to a liquid. Cf. critical point.

**Point, Quadruple.** In a two component system of four phases a point where the four phases are in equilibrium. In two component systems where more than four phases are present several quadruple points may result.

**Polariscope.** An instrument used for the direct measurement of the angular rotation produced in a ray of polarized light by an optically active substance.

**Polarity.** A property or condition of a body by virtue of which it exhibits opposite and contrasted properties in opposite and contrasted directions, e.g. attraction and repulsion at opposite ends of a bar magnet.

**Polarization.** 1. Polarization of light, see light, polarized. 2. The production of a counter E.M.F. in electrolysis due to the tendency of the products to reunite. Cell polarization is produced when the products of

electrolysis are chemically different from the electrodes, viz., the deposition of hydrogen on a copper cathode causes polarization.

**Polarized Light.** See light, polarized.

**Polarizer.** A device for obtaining polarized light, especially that Nicol prism in a polariscope which is nearest the source of light.

**Pollen.** (bot.) The fertilizing grains of plants.

**Polonium.** Radioactive element announced by Mme. Curie which occurs in the products of the degradation of radium. It has not yet been isolated.

**Polyatomic.** Containing more than two hydroxyl groups, as polyatomic alcohols, glycerol, erythrose.

**Polybasic.** An acid which contains more than two replaceable hydrogen atoms.

**Polychromic.** A compound which exhibits several colors, as eosin.

**Polychromatic.** A compound which exhibits a variety or a change of colors.

**Polygens.** Elements which can combine in two or more proportions, as chromium, iron, sulphur, oxygen, nitrogen.

**Polymeric.** The condition of being a polymer.

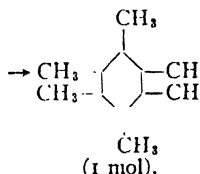
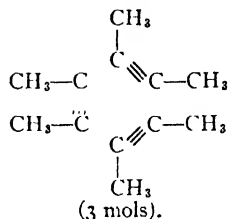
**Polymerid.** A polymer.

**Polymerism.** Isomerism in which the isomers are of different molecular weights.

**Polymerization.** A union of two or more molecules of the same substance to produce a new compound without elimination of any secondary compound (distinction from condensation).

A typical case of polymerization is the conversion of formaldehyde to paraformaldehyde, viz.,  $3\text{CH}_2\text{O} \rightarrow \text{C}_3\text{H}_6\text{O}_3$ . Among inorganic compounds polymerization is shown by some metaphosphates.

**Polymerization, Aromatic.** The polymerization of an aliphatic substance to form a carbocyclic compound, as in the polymerization of crotonylene to hexamethylbenzene, viz.,



**Polymerization, Carbohydrate.** The photosynthesis of sugars from formaldehyde.

**Polymerization of Solvents.** See association.

**Polymerize.** To unite with itself to produce a polymer.

**Polymers.** Substances of identical elementary composition but of different mass, as acetylene,  $\text{C}_2\text{H}_2$ , and benzene,  $\text{C}_6\text{H}_6$ ; formaldehyde,  $\text{CH}_2\text{O}$ , paraformaldehyde,  $\text{C}_3\text{H}_6\text{O}_3$ , and dextrose,  $\text{C}_6\text{H}_{12}\text{O}_6$ . Polymers are sometimes termed isomers, isomers of equal mass being distinguished as metamers.

**Polymerous.** 1. Polymeric. 2. Tending to polymerize.

**Polymorphic.** Existing in three crystalline forms.

**Polymorphism.** A phenomenon in which a substance exhibits different crystal forms. Dimorphic substances appear in two crystal forms, while polymorphs exist in three, as sulphur, carbon, tin, silver iodide, and calcium carbonate. Polymorphism is restricted to the solid state. Polymorphs yield identical solutions and vapors (if vaporizable). The relation between them has been termed "physical isomerism" and the polymorphs have been termed "physical isomers."

**Polymorphs.** Substances which exhibit three crystalline forms. "Physical isomers."

**Polypeptides.** Synthetic compounds composed of several amino acids and similar in many properties to the natural peptones. They may be termed di-, tri-, tetra-, etc., peptides according to the number of amino acids present in the molecule. See proteins.

**Polysaccharoses.** (Polysaccharides, amyloses.) A class of carbohydrates characterized by amorphous, complex structure and lack of sweet taste, as starch, dextrin, inulin. On hydrolysis they yield several molecules of monosaccharoses.

**Polyvalent.** Having a valence greater than three.

**Potash.** Potassium carbonate,  $K_2CO_3$ .

**Potassic.** Containing potassium.

**Potassium.** Metallic element. K. At. Wt. 39.1. S. G. 0.8621. S. heat 0.1662. M. P. 63.6°. B. P. 757.5°. Valence 1. Occurs in silvite, carnallite, sea water. Oxides,  $K_2O$ ,  $K_2O_2$ .

**Potassoxyl.** The radical KO. (Obs.)

**Potentiometer.** Any instrument used to measure or compare electric potentials.

**Pound.** A unit of mass in the avoirdupois and Troy systems.

1 pound av.	equals	16 av. ounces.
1 " " "	"	7,000 grains.
1 " " "	"	0.45359 Kg.
1 " " "	"	453.59 gm.
1 " Troy "	"	373.24 gm.
1 " " "	"	12 ounces Troy.
1 " " "	"	5760 grains.

**Poundal.** The unit of force in the English system defined as the force which, acting on a pound mass for one second, imparts to it a velocity of one foot per second. 1 poundal equals 13.825 dynes.

**Praseo-.** A prefix, from the Greek praseos, which denotes a green color.

**Praseodymium.** Metallic element. Pr. At. Wt. 140.9. S. G. 6.4754. M. P. 940°. Valence 3. Occurs in cerite and other rare minerals. Oxides  $PrO_2$ ,  $Pr_2O_3$ .

**Precipitable.** Capable of being precipitated.

**Precipitant.** A reagent which may cause a precipitate.

**Precipitation.** The act of producing a precipitate in any system.

**Precipitate.** 1. A solid or liquid separated from a solution by a chemical or physical process which renders it insoluble. 2. (To precipitate.) To render a dissolved substance insoluble or to react on it in such a way as to produce an insoluble derivative. Precipitation may be due to altering the temperature or to lessening the volume of the solvent; to coagulation, as in the case of certain protein solutions; to driving off a gas which has held a substance in solution, as  $CaCO_3$  in aqueous  $CO_2$  solutions; by the addition

of some substance in the presence of which a solute becomes insoluble, as the salting out of phenol; by adding some reagent which reacts with the solute producing an insoluble substance; and by adding a second solvent in which the solute is insoluble, as in adding alcohol to a saturated aqueous solution of sodium chloride. In the language of the ionization hypothesis a precipitate occurs when an electrically neutral species of molecule exceeds the amount of its solubility product.

**Precipitation, Fractional.** Separation of a mixture in solution by the addition of a reagent in sufficient quantity only to precipitate one constituent (the least soluble). By this method mixtures of the sodium salts of organic acids in water solution may be separated.

**Pressure.** Force per unit area. Pressure is expressed in dynes per square centimeter or pounds per square inch.

**Pressure, Atmospheric.** The normal atmospheric pressure, or pressure of one atmosphere, is 1,012,630 dynes per sq. cm. or 14.7 pounds per sq. inch. This will support a column of mercury (in a barometer) 76 cm. high.

**Pressure, Critical.** The pressure necessary to condense a gas at the critical temperature.

**Pressures, Fugitive.** (Transitory pressures.) Local variations of pressure in the vicinity of an explosion wave, in rapidly burning mixtures, much greater than the mean pressure of the whole mass of gas, produced either in the compression wave or the explosion wave.

**Primary Alcohol.** See alcohol.

**Primary Amine.** See amine.

**Primary Nuclei.** The nucleus radicals in Laurent's nucleus theory. Sub-

stitution of other elements for the hydrogen of the primary nucleus produced secondary nuclei.

**Principal Valence.** See valence.

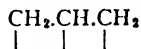
**Procumbent.** (bot.) Lying on the ground.

**Producer.** An apparatus for the manufacture of illuminating and fuel gas by the reaction between steam and coal at 1,000°. The producer process differs from the "water gas" process in that the coal is kept at the proper high temperature by an air blast introduced with the steam instead of alternately. The product of the apparatus is known as producer gas. Mond gas is a special type of this gas.

**Prolamines.** (Glaidsins.) See proteins.

**Propanolysis.** Alcoholysis in which the alcohol split is propyl alcohol.

**Propenyl Group.** (Glyceryl group.) The trivalent aliphatic group



present in glycerol.

**Properties, Polar.** Properties which necessarily have two opposite values, as electric charges.

**Property.** That which is inherently characteristic of a substance and naturally essential to it.

**Proportions, Definite, Law of.** See law of definite proportions.

**Propyl-.** The univalent group  $\text{CH}_3\text{--CH}_2\text{CH}_2\text{--}$ .

**Propylidene.** The divalent group  $\text{CH}_3\text{CH}_2\text{CH}:\text{CH}_2$ . Also called propidine.

**Propionyl.** The acyl group  $\text{CH}_3\text{--CH}_2\text{C}:\text{O--}$  derived from propionic acid.

**Prosthetic Group.** That portion of a protein molecule which is not protein in nature, e.g. nucleic acids in the nucleoproteids, or carbohydrate groups in the glucoproteids. It is analogous to the aglycone group of a glucoside.

**Protamines.** A class of simple proteins. See proteins.

**Protease.** An enzyme which catalyzes the hydrolysis of proteins, as pepsin.

**Proteid.** 1. A member of a class of proteins characterized by content of a prosthetic group, as nucleoproteids, chromoproteids, glucoproteids. 2. A term often used synonymously with "protein." It is better to abandon this use of the term in favor of the more restricted sense.

**Proteidid.** A generic term for a class of bacteriolytic enzymes "combined" with blood albumins which have immunizing and curative properties.

**Proteinogenous.** Produced by a protein, especially by the decomposition of a protein, as a proteinogenous amine such as histamine or p-hydroxyphenylethylamine.

**Proteins.** (Proteids, albumins.) A class of complex organic compounds of high molecular weight and their immediate derivatives, found associated with living matter, though some simple proteins have been prepared synthetically. They consist of carbon, hydrogen, nitrogen, and oxygen, with sulphur, phosphorus, iron, copper, chlorine, iodine, and a few other elements, in individuals. They are classified in several ways: the system adopted by the American Society of Biological Chemists is as follows:—

I. Simple proteins. On hydrolysis these yield amino acids or their derivatives alone.

- A. Albumins. Soluble in water and dilute saline solutions, coagulable by heat. Egg albumin, serum albumin.
  - B. Globulins. Insoluble in water, soluble in dilute saline solutions, coagulable by heat. Edestin, serum globulin.
  - C. Glutelins. Insoluble in water or dilute salt solutions, soluble in very dilute acids or alkalies, coagulable by heat. Glutenin.
  - D. Prolamines. Insoluble in water, soluble in 80% alcohol. Glaidin, hordein, zein.
  - E. Albuminoids. Insoluble in dilute acid, alkali, water, or salt solutions. Elastin, keratin, collagen.
  - F. Histones. Soluble in water and dilute acids, precipitated by ammonia, strongly basic, not coagulable by heat. Histone.
  - G. Protamines. Soluble in ammonia, not coagulable by heat, strongly basic, yielding large amounts of diamino acids on hydrolysis. Sturnin, salmin, clupein.
- II. Conjugated proteins. Compounds of simple proteins with prosthetic groups.
- A. Hemoglobins. (Chromoproteins.) The prosthetic group is colored. Hemoglobin, hemocyanin, phycoerythrin.
  - B. Glycoproteins. (Glucoproteins.) The prosthetic group contains a carbohydrate residue. Mucin, ichthulin.
  - C. Phosphoproteins. Proteins of cytoplasm. The prosthetic group contains phosphoric acid but neither nucleic acid nor a phospholipin. Casein, vitellin.
  - D. Nucleoproteins. The prosthetic group is nucleic acid. Nuclein, nucleohistone.
  - E. Lecithoproteins. The prosthetic group is lecithin or a phos-



pholipin. No member of this class has been isolated.

F. Lipoproteins. (Mathews.) The prosthetic group is a higher fatty acid.

III. Derived proteins. Decomposition products of the natural proteins and synthetic products.

A. Primary protein derivatives.

a. Derived proteins, the first products of the action of acids, enzymes, or water. Insoluble in water.

b. Metaproteins, produced by further action of acids or alkalis. Insoluble in neutral solutions, soluble in weak acids and alkalis. Acid albumin.

c. Coagulated proteins, produced by the action of heat or alcohol, insoluble.

B. Secondary protein derivatives.

a. Proteoses. Hydrolytic decomposition products of proteins, soluble in water, not coagulable by heat, ppd. by saturating their solutions with ammonium sulphate.

b. Peptones. Hydrolytic decomposition products of proteins, not coagulable by heat, soluble in water, not ppd. by saturation with ammonium sulphate.

c. Peptides. Compounds of amino acids of known composition. The synthetic polypeptides are included in this class.

The system of classification proposed by the English Society of Physiologists is:—

I. Simple proteins.

1. Protamines.
2. Histones.
3. Globulins.
4. Albumins.
5. Glutelins.
6. Glaidins (prolamines).

7. Sclero-proteins.

8. Phosphoproteins.

II. Conjugated proteins.

1. Chromoproteins.

2. Nucleoproteins.

3. Glucoproteins.

III. Hydrolyzed proteins.

1. Metaproteins.

2. Albumoses or proteoses.

3. Peptones.

4. Polypeptides.

**Proteoclastic.** Proteolytic. See enzymes, proteolytic.

**Proto-.** A prefix denoting "first," as protoiodide. (Obs.)

**Proto-Fluorine.** (PrF.) An unknown element, assumed to exist in certain nebulae. Its atomic weight has been calculated to be 2.1.

**Proto-Hydrogen.** (PrH.) An unknown element, assumed to exist in certain nebulae. Its atomic weight has been calculated to be 0.082.

**Protones.** A class of substances intermediate between the amino acids and the protamines, prepared from the latter by mild hydrolysis. They bear to the protamines a relation similar to that which the peptones bear to the proteins.

**Proximate Principle.** In phytochemistry, an alkaloid, glucoside, or bitter principle upon which the properties, especially the medicinal properties, of a plant depend.

**Pseudo-.** A prefix denoting "near" or "similar to," as pseudo-acid, pseudo-tannin. Pseudo is often designated by the Greek letter  $\psi$ .

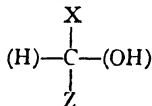
**Pseudo-Acids.** A term applied by Hantzsch to the tautomeric forms of certain nitro compounds which form salts with bases.

**Pseudo-Alums.** A series of double sulphates resulting from the substi-

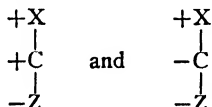
tution of the sulphates of certain bivalent elements, manganese, ferrous iron, copper, zinc, and magnesium, for the sulphates of univalent metals in the true alums, e.g.  $\text{Al}_2(\text{SO}_4)_3 \cdot \text{MnSO}_4 \cdot 24\text{H}_2\text{O}$ , a pseudo-alum.

**Pseudo-Ammonium Bases.** A group of compounds corresponding to the pseudo-acids. They are not in themselves bases but exhibit ionic isomerism, q.v.

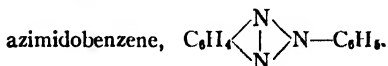
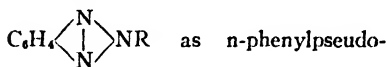
**Pseudo-Asymmetry.** Asymmetry caused by a non-asymmetric carbon atom becoming asymmetric due to a change in the configuration of asymmetric groups with which it is associated. Thus, in an asymmetric compound of the type



where X and Z are asymmetric groups and C is inactive, as long as X and Z are of the same rotation C remains inactive; but let X and Z assume opposite rotations and C becomes asymmetric and, although it does not affect the optical rotation of the compound, it does produce two different inactive substances, viz.,



**Pseudo-Azimides.** Derivatives of the nucleus



**Pseudo-Binary.** See unary.

**Pseudo-Catalysis.** (Catalysis by transvection, cyclic action.) A type of cyclic action in which one of the factors of a reaction appears among the products unchanged although it has taken part in the reaction (distinction from true catalysis).

**Pseudo-Celluloses.** (Reserve celluloses.) Hemicelluloses.

**Pseudo-Isomerism.** A term applied to tautomerism. See isomerism, dynamic.

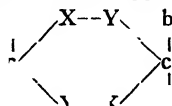
**Pseudomerism.** Tautomerism. See isomerism, dynamic.

**Pseudomorphism.** A phenomenon in which a substance exhibits an abnormal crystalline form. Substances which show this are termed pseudomorphous.

**Pseudomorphous.** See pseudomorphism.

**Pseudo-Solutions.** Solutions which do not obey the usual physical laws applying to solutions, as the law of osmotic pressure, raising of the boiling point, and lowering of the freezing point. Colloidal solutions are often spoken of as pseudo-solutions.

**Pseudo-Symmetry.** (Compound symmetry, indirect symmetry.) 1. The condition of certain inactive indivisible types of asymmetric compounds which contain two structurally similar asymmetric carbon atoms and are without a plane of symmetry yet whose reflected image is identical with them, as a compound of the type

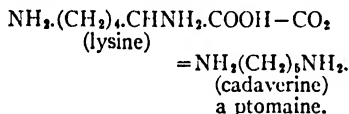


in which the a-c-b groups are assumed to be at right angles to the plane of the ring. One-half of the compound must be rotated through

an angle of  $180^\circ$  to make the configuration symmetrical. N.B. This type is not a meso type. 2. In crystals, twins or fourlings which show forms that apparently belong to crystal systems of higher symmetry than the system of the single individual. These are termed pseudo-symmetric or mimetic.

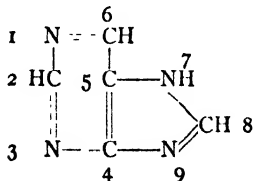
**Pseudo-Tannins.** Tannoidal substances which cannot convert hide into leather, e.g. caffetannic acid, hop tannin, etc.

**Ptomaine.** (Cadaveric alkaloid, aporrhagma.) Any one of a class of strong amine bases formed by the bacterial or metabolic splitting of carbon dioxide from the amino acids. They are, in general, very toxic exerting a powerful effect upon the blood pressure. Formation:



**Pubescent.** (bot.) Covered with hairs, especially soft hairs.

**Purine.** A nitrogenous cyclic compound, the parent of several important bases, uric acid, etc. The purine complex is numbered as follows:



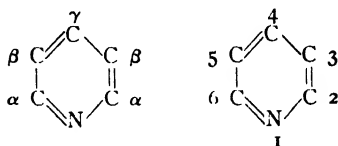
**Putamen.** (bot.) The shell of a nut.

**Putrefaction.** A form of decomposition brought about by micro-organisms and characterized by com-

plexity of process and by the offensive nature of the products.

**Pycnometer.** (Pyknometer.) A standardized vessel used in determining the specific gravity of a liquid.

**Pyridine Derivatives.** Derivatives of the heterocyclic substance pyridine,  $\text{C}_5\text{H}_5\text{N}$ . The isomerism of pyridine derivatives is similar to that of benzene derivatives. The pyridine ring is lettered or numbered thus,



**Pyridyl Group.** The univalent group  $\text{N}(\text{CH})_4\text{C}-$  derived from pyridine, to which it bears the same relation that phenyl does to benzene.

**Pyro-** } Prefixes used to denote high  
**Pyro-** } temperature or products  
derived from systems which have been subjected to high temperature, as pyrogallol, a product of the dry distillation of gallic acid at elevated temperatures, or as pyrometer, q.v.

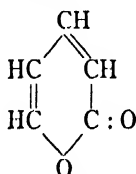
**Pyro-Electric Excitement.** A phenomenon observed in certain crystals, e.g. tourmaline, which become electrically charged upon uniform, and in some cases uneven, heating or cooling (thermal deformation). One end of the crystal becomes positively charged and the other end negatively charged.

**Pyro-Electricity.** Electricity produced by pyro-electric excitement, v. supra.

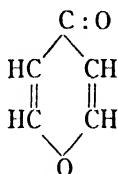
**Pyrometer.** An instrument used for measuring high temperatures, usually those higher than can be indicated on the mercury thermometer, as the melting point of iron, the temperature of a blast furnace, etc.

**Pyrometry.** The art of measuring high temperatures.

**Pyrones.** A class of heterocyclic oxygen compounds derived from  $\alpha$  and  $\gamma$  pyrone, e.g.



( $\alpha$  pyrone)



( $\gamma$  pyrone)

The pyrone derivatives are important as possible basic compounds from

which alkaloids are synthesized in plants.

**Pyrophorus.** A mass of finely divided material which takes fire on contact with the air. Finely divided iron, cobalt, nickel, and other substances show this phenomenon. The ratio of exposed surface to the mass to be heated is so great that the surface oxidation generates sufficient heat to raise the temperature to incandescence.

**Pyrophosphoryl.** The quadrivalent radical  $P_2O_3$  derived from pyrophosphoric acid, e.g. pyrophosphoryl chloride,  $P_2O_3Cl_4$ .

## Q.

**Quadribasic.** Capable of neutralizing four molecules of monacid base, as pyrophosphoric acid.

**Quadrimeric Reactions.** Reactions of the fourth order. See reactions.

**Quadroxide.** An oxide which contains four oxygen atoms to one of other element.

**Quadrivalence.** Condition of being quadrivalent.

**Quadrivalent.** (Tetravalent.) Having a valence of four.

**Qualitative.** See analysis.

**Quantitative.** See analysis.

**Quantity.** The quantity of a chemical compound in any reaction or mathematical formula for an equilibrium is taken as the number of gram molecules present. "Amount," "quantity," "active mass," and "concentration" are used synonymously in chemistry.

**Quantivalence.** Valence, q.v.

**Quantum of Energy.** ( $\epsilon$ ) See quantum theory.

**Quantum Theory of Energy.** The absorption or evolution of energy is not a continuous process but takes place in jumps or pulsations always in multiples of a definite quantity called the quantum of energy ( $\epsilon$ ) and never in fractions of this quantity. The quantum is not a constant quantity but is proportional to the frequency ( $\nu$ ) of the radiation, viz.,

$$\epsilon = h\nu,$$

where  $h$  is a universal constant (Planck's constant) of the numerical value  $6.5 \times 10^{-27}$  erg-seconds.

**Quarentoxide.** An oxide in which the proportion of divalent metal to oxygen is as four to one, e.g.  $\text{Cu}_4\text{O}$ .

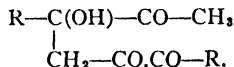
**Quart.** A unit of dry and liquid measure in the English system.

1 U. S. liquid quart = 0.94636 liter.  
1 " " " = 2 U. S. pints.  
4 " " quarts = 1 U. S. gallon.  
1 Imperial quart = 1.13586 liter.  
1 U. S. Dry quart = 1.1012 "

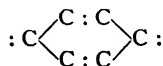
**Quinhydrones.** Compounds of the quinones and hydroquinones produced by direct addition. They are frequently formed as intermediate products during the reduction of quinones.

**Quinocarbonium Salts.** Salts of non-nitrogenous organic compounds with mineral acids in which the acid is combined with carbon (carbonium valence). A rearrangement of the molecule occurs with production of quinoid structure and development of color.

**Quinogens.** Intermediate products in the condensation of aliphatic  $\alpha$  diketones to quinones. General formula,

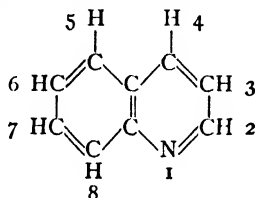


**Quinoid Form.** The atomic grouping



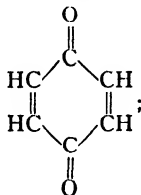
characteristic of quinones and believed to be the chromophore in certain colored benzene derivatives. Cf. benzenoid. Since the preparation of orthoquinone derivatives it has been necessary to distinguish the above grouping as the "paraquinoid" to avoid confusion. The unqualified term "quinoid" however, always refers to the above group. Cf. orthoquinoid.

**Quinoline.** A basic heterocyclic compound of the formula,

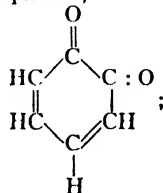


The carbon atoms of the pyridine nucleus may be designated by Greek letters and those of the benzene nucleus numbered. Carbon No. 5 is also known as the "ana" position, while 8, 7, and 6 may be termed ortho, meta, and para. Substitution in the pyridine nucleus may be distinguished by the notation Py 1, Py 2, or Py 3 instead of by the Greek letters.

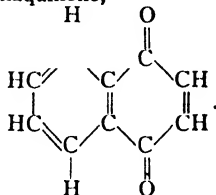
**Quinones.** Dioxy derivatives of cyclic hydrocarbons characterized by peculiar arrangement of double bonds, e.g. para-benzoquinone,



ortho-benzoquinone,



$\alpha$ -naphthaquinone,



**Quinoyl.** 1. A name originally applied to p-benzoquinone. 2. A term used to designate the quinone group oxygen.

**Quinolyl.** The radical  $C_8H_7N$ —derived from quinoline to which it bears the same relation that phenyl does to benzene.

**Quinquemolecular Reactions.** Reactions of the fifth order. See reactions.

**Quinquevalent.** (Pentavalent.) Having a valence of five as nitrogen, arsenic, and phosphorus.

**Quintessence.** 1. An extract. 2. An essential oil. 3. The ether. 4. The fifth element of the Pythagoreans.

## R.

**R.** Symbol for the gas constant and, in formulas, for "radical" or "ring."

**Racemation.** Racemization.

**Raceme.** } A form of optically inactive compound which consists of equal quantities of the dextro and laevo forms of optical isomers. They crystallize in holohedral, not in hemihedral, crystals and may be resolved into the enantiomorphs by several methods; see resolution, and inactive compounds.

**Racemization.** (Racemation.) The rendering inactive of an optically active substance by converting it into the racemic form. Heating is the usual method of effecting the conversion. Some substances racemize spontaneously at ordinary temperatures (autoracemization), others are not completely racemized but sometimes only a single asymmetric group is affected (partial racemization).

**Racemization, Partial.** Incomplete racemization of compounds which contain several asymmetric carbon atoms in which only a single asymmetric group is affected by the racemizing process.

**Racemized Proteins.** Proteins which have been treated with concentrated alkali whereby their optical activity is diminished.

**Radiant Energy.** Dynamic disturbances in the ether transmitted through space in waves with a speed

of  $3 \times 10^{10}$  cm. per second. Light, radiant heat, and electrical waves are all forms of radiant energy.

**Radiant Heat.** See radiant energy.

**Radiation Pressure.** A pressure upon the absorbing body equal to the specific density of the radiant energy being absorbed. If absorption is incomplete the pressure is greater and is doubled when the radiation is completely reflected.

**Radiation Temperature.** See law of Stefan.

**Radical.** A group of atoms which may enter into several combinations as a unit and take part in reactions like elementary substances, viz.,  $\text{NH}_4$ ,  $\text{CH}_3$ ,  $\text{C}_6\text{H}_5$ ,  $\text{C}_6\text{H}_5\text{C} : \text{O} - \text{O} \cdot \text{SO}_4$ . Radicals differ from atomic groups mainly in that they may be either the basic or acidic portion of a salt or salt-like compound. Groups may be considered as atomic complexes which confer specific properties upon the compounds which contain them. Many radicals do this as well.

**Radical, Dissimulated.** A radical which is so combined in an atomic complex that it no longer reacts in normal fashion. Ex. In certain modifications of chromium sulphate in solution only a fraction of the total sulphate radicals present may be precipitated by barium chloride; the remainder is supposed to be dissimulated.

**Radical Theory.** The old theory of Lavoisier according to which inorganic oxides are oxides of a simple radical

and oxygenated carbon compounds are oxides of compound radicals.

**Radicals, Multivalent.** Radicals of valence greater than two, as the methine group.

**Radio-.** A prefix which indicates connection with the phenomena of radiant energy or of radioactivity.

**Radioactive Elements.** Although theoretically all substances are radioactive, radium, thorium, and uranium, in which this property is highly developed are termed the radioactive elements. The products of these elements, actinium, polonium, radiums A, B, C, etc., Thorium X, etc., are considered in the class of radioactive elements.

**Radioactivity.** The spontaneous emission of radiant energy. It is recognized by effects produced upon the photographic plate, power to produce phosphorescence in certain substances as platinocyanides, crystalline zinc sulphide, or willemite, and power to ionize gases.

**Radiometer.** An instrument used to measure the mechanical effects of radiant energy.

**Radiomicrometer.** A sensitive thermopile used to detect minute changes of radiant energy.

**Radium.** Metallic element. Ra. At. Wt. 226.4. Radioactive. Occurs in pitchblende. Valence 2. Period of half decay, 1,300 years.

**Raoult's Law.** See law of Raoult.

**Ray.** In wave motion a line from the center of disturbance at right angles to the wave front everywhere indicating the direction of motion of the waves.

**Rays, Actinic.** See rays, chemical.

**Rays, Alpha. ( $\alpha$ .)** Streams of positively charged helium atoms emitted by some radioactive substances.

**Rays, Becquerel.** The radiation given out by a radioactive element.

**Rays, Beta. ( $\beta$ .)** Rays emitted by radium, apparently identical with cathode rays.

**Rays, Cathode.** Streams of negative electrons produced by passing a high frequency electric current through a highly evacuated tube. The stream of electrons is luminous, passes from cathode to anode and is deflected by a magnet placed in certain positions. Lenard rays are cathode rays extending a short distance outside the walls of the tube which contains the cathode rays.

**Rays, Chemical.** (Actinic rays.) Light rays capable of producing chemical effects.

**Rays, Gamma. ( $\gamma$ .)** Rays of great penetrating power analogous to Röntgen rays and emitted from radium and certain other radioactive substances.

**Rays, Lenard.** See cathode rays.

**Rays, Rontgen. (X rays.)** A type of radiation produced whenever cathode rays impinge on the walls of the tube or upon obstacles placed within it. They penetrate many substances through which the cathode rays do not pass, are not deflected by a magnet, excite phosphorescence in many substances and ionize gases.

**Rays, X.** See rays, Röntgen.

**React.** To enter into chemical action with.

**Reactants.** The initial factors of a reaction, e.g. in the reaction,  $\text{HCl} + \text{KOH} = \text{KCl} + \text{H}_2\text{O}$ , the reactants are HCl and KOH.



**Reacting Weight.** The equivalent weight, q.v.

**Reaction.** 1. A reaction is a process in which one form of matter is transformed into another form or other forms which have different properties. An energy change is always involved. 2. The "reaction" of a system is its acidity, alkalinity, or neutrality.

**Reaction, Barbier-Grignard.** (Grignard reaction.) See condensation, magnesium alkyl.

**Reaction, Beckmann's.** See Beckmann rearrangement.

**Reaction, Claisen.** See condensation, Claisen's.

**Reaction, Etard's.** The oxidizing of methyl groups in hydrocarbons to aldehyde groups by means of chromyl chloride,  $\text{CrO}_2\text{Cl}_2$ .

**Reaction, Factors of.** (Reactants.) The substances which are transformed during a reaction.

**Reaction, Fittig's.** (Fittig's synthesis.) A reaction used to prepare homologues of benzene and other cyclic hydrocarbons by acting on a mixture of alkyl iodide or bromide and aryl iodide or bromide with metallic sodium whereby sodium halide and alkyl-derivative of the hydrocarbon are formed.

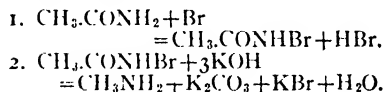
**Reaction, Frankland's.** See condensation, zinc-alkyl.

**Reaction, Friedel-Crafts'.** The synthesis of aromatic hydrocarbon derivatives by the action of anhydrous aluminium chloride upon a mixture of hydrocarbon and alkyl or acyl halide, a halogen hydride being split out.

**Reaction, Gattermann's.** The preparation of halogen compounds from diazotized amine halides by the use of finely divided copper.

**Reaction, Grignard.** See condensation, magnesium-alkyl.

**Reaction, Hofmann's.** The action of bromine in alkaline solution upon the acid amides whereby carbon monoxide is eliminated and amines are formed, e.g. the preparation of methylamine from acetamide:



**Reaction Isochore.** (Isochore of van't Hoff.) An expression which gives the influence of temperature on the equilibrium constant ( $K$ ) at constant pressure (or volume), viz.

$$\frac{d \ln K}{dT} = \frac{Q}{RT^2}$$

where  $Q$  = the decrease in total energy and  $R$  = the gas constant per mol.

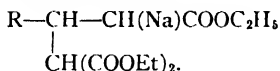
**Reaction Isotherm.** (Isotherm of van't Hoff.) An expression which gives the maximum external work that can be obtained from a given chemical process (at constant temperature) occurring in a gaseous system. The work is expressed in terms of the equilibrium constant ( $K$ ), viz.,  $A = RT \log K - RT \sum v \log C$ , where  $A$  = the decrease in free energy,  $R$  = the gas constant per mol, and  $RT \sum v \log C$  is the concentration term.

**Reaction, Main.** See reactions, side.

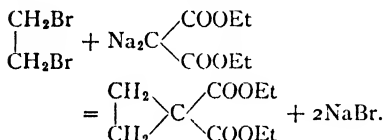
**Reaction, Metathetical.** See metathesis.

**Reaction, Michael's.** A reaction in which the sodium compounds of acetacetic and malonic esters add to unsaturated compounds of the type  $\text{R}-\text{CH}:\text{CH}-\text{X}$  or  $\text{R}-\text{C}::\text{C}-\text{X}$ , where  $\text{R}$  is a positive or negative organic radical and  $\text{X}$  is a strongly negative radical like carbonyl or

cyanogen. Cinnamic, fumaric, maleic, and citraconic esters, and benzylidene acetone react in this way. The addition takes place thus,



**Reaction, Perkin Jr.** A reaction between the sodium compound of either acetacetic ester or malonic ester and a dibromide (as ethylene dibromide) which results in the formation of a cyclic compound, e.g.



**Reaction, Perkin Sr.** (Perkin's reaction.) The formation of unsaturated acids by heating an aliphatic or aromatic aldehyde with the anhydride of a fatty acid and its anhydrous sodium salt to  $180^\circ$  for several hours. The mechanism of the reaction is not settled.

**Reaction, Principal.** See reactions, side.

**Reaction, Sandmeyer's.** The replacement of the amino group in aromatic amines by halogen. The amine is diazotized and the product treated with a cuprous halide when nitrogen is evolved and an aromatic halogen compound produced. The reaction may also be used to prepare nitro compounds from amines.

**Reaction, Schotten-Baumann.** Benzoylation with benzoyl chloride in alkaline solution. The compound to be acylated is dissolved in dilute alkali and the mixture shaken with benzoyl chloride until the odor of the latter is imperceptible.

**Reaction, Secondary.** See reactions, side.

**Reaction, Skraup.** The preparation of quinoline and its derivatives from an aromatic amine (aniline and its derivatives), glycerol, sulphuric acid, and an oxidizer (nitrobenzene or arsenic oxide). The glycerol yields acrolein, which condenses with the aniline and the acrolein-aniline thus produced condenses to quinoline.

**Reaction, Specific Speed of.** The rate of change divided by the concentration of the reacting substance or substances.

**Reaction, Synthetic.** (Synthesis.) The combining of elements or compounds to form products of greater molecular weight, e.g.  $\text{H}_2 + \text{Cl}_2 = 2\text{HCl}$ .

**Reaction, Tiemann-Reimer.** The preparation of oxy-aldehydes by the interaction of a phenol, chloroform, and aqueous alkalis. The aldehyde group enters the ortho and para positions with respect to the hydroxyl. Oxyacids are similarly produced from carbon tetrachloride.

**Reaction Velocity.** The time rate of change of a factor (or of all the factors) in a chemical reaction. If  $x$  equals the amount of substance present at any time  $t$ , and  $dx$  represents the small amount of the substance changed in the small time-interval  $dt$ , then the velocity of the reaction equals  $dx/dt$ . Cf. reactions, unimolecular and bimolecular.

**Reaction, Wurtz.** A reaction between alkyl iodides and sodium whereby sodium iodide and a paraffin hydrocarbon are formed.

**Reactions, Balanced.** (Reversible, incomplete, counter, or opposing reactions). Reactions in which, under usual conditions, the products react to reform the factors so that a state of

equilibrium is finally reached in which, at any definite temperature, the concentrations of factors and products are constant, e.g.  $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ . The reversed pointers  $\rightleftharpoons$  are used to denote that the reactions proceed from either side. At equilibrium the velocity of the esterification reaction in the example is equal to that of the hydrolysis, and, although the system is in continual reaction, the concentrations suffer no change.

**Reactions, Bimolecular.** (Dimolecular.) Reactions of the second order. The more common type of chemical reaction in which two substances are undergoing change, as the reaction of alkali hydroxides on the salts of heavy metals, the hydrolysis of esters by alkalis, etc. According to that mass law the velocity of a bimolecular reaction may be expressed as follows:

$$\frac{dx}{dt} = k(a-x)(b-x),$$

which, on integration, becomes

$$\frac{1}{t_2 - t_1} \log \frac{a - x_2}{b - x_2} - \log \frac{a - x_1}{b - x_1} = K(a - b),$$

where  $a$  and  $b$  = the initial concentrations of the reacting substances and  $x_1$  and  $x_2$  denote the amounts which have been transformed in time  $t_1$  and  $t_2$ . The above expression allows for cases where the initial concentrations of the reacting substances are not equivalent.

**Reactions, Composite.** Reactions which involve more than one simple change, e.g. consecutive and simultaneous reactions.

**Reactions, Concurrent.** Two reactions which proceed together, neither of which can take place separately, form a concurrent reaction, e.g. the preparation of chromic chloride by the simultaneous action of carbon and

chlorine upon chromic oxide,  $2\text{Cr}_2\text{O}_3 + 3\text{C} + 6\text{Cl}_2 = 4\text{CrCl}_3 + 3\text{CO}_2$ , which may be "dissected" into the (hypothetical) reactions,

1.  $2\text{Cr}_2\text{O}_3 + 6\text{Cl}_2 = 4\text{CrCl}_3 + 3\text{O}_2$ ,
2.  $2\text{Cr}_2\text{O}_3 + 3\text{C} = 3\text{CO}_2 + 4\text{Cr}$ ,
3.  $4\text{Cr} + 6\text{Cl}_2 = 4\text{CrCl}_3$ ,
4.  $3\text{O}_2 + 3\text{C} = 3\text{CO}_2$ .

**Reactions, Counter.** See reactions, balanced.

**Reactions, Coupled.** See reactions, induced.

**Reactions, Incomplete.** See reactions, balanced.

**Reactions, Independence of.** If in any system several simultaneous reactions are taking place, each reaction proceeds as if it were independent of all the rest and according to the law of mass action. At the establishment of equilibrium the condition of the system is the sum of all the changes. (Coexistence of reactions.)

**Reactions, Induced.** (Sympathetic or coupled reactions.) A chemical process in which a slow reaction between A and B is accelerated by a simultaneous rapid reaction between A and C. The fastest reaction is termed the primary reaction, the accelerated reaction is the secondary reaction. The substance which takes part in both reactions is the "actor," the second factor in the primary reaction is termed the "inductor" and the second factor in the secondary reaction is named the "acceptor."

**Reactions, Irreversible.** (Complete reactions.) Reactions which proceed until one or all of the factors have been exhausted, as the union of hydrogen and chlorine to form hydrochloric acid. In these reactions the products do not react to reform the factors under the conditions of the main reaction. Cf. reactions, balanced.

**Reactions, Monomolecular.** See reactions, unimolecular.

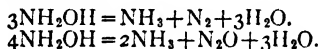
**Reactions, N Molecular.** Reactions of the  $n$ th order. The coefficient  $K$  of such reactions is inversely proportional to the  $(n - 1)$ th power of the initial concentration of the reacting substances.

**Reactions, Opposing.** See reactions, balanced.

**Reactions, Primary.** See reactions, induced.

**Reactions, Reversible.** See reactions, balanced.

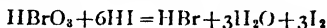
**Reactions, Side.** (Simultaneous reactions.) Two or more reactions occurring simultaneously between the same factors giving rise to different products, e.g.



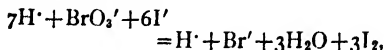
The predominating reaction is termed the main or principal reaction, the other, the secondary reaction. The term side reaction is often used in the sense of the secondary reaction.

**Reactions, Simultaneous.** See reactions, side.

**Reactions, Subsidiary.** A special type of simultaneous reaction in which a transformation of one of the factors of the reaction occurs concomitantly with and dependently on the main reaction which, in turn, is dependent upon this subsidiary reaction, e.g. according to Nernst the reaction



may be expressed,



which may be dissected into two reactions,  $6\text{H}^+ + \text{BrO}_3' = \text{Br}' + 3\text{H}_2\text{O}$  and  $6\text{I}' = 3\text{I}_2$ . Here the latter reaction

is the subsidiary. The electrical charge furnished by it is needed to neutralize the charges on the free hydrogen ions in the main reaction.

**Reactions, Sympathetic.** See reactions, induced.

**Reactions, Termolecular.** (Trimolecular reactions.) Reactions of the third order. Reactions in which three substances or molecules are simultaneously transformed into new products. The expressions for the velocities of such reactions vary according to the relative concentrations of the reacting substances.

**Reactions, Quadrimolecular.** (Tetramolecular reactions.) Reactions of the fourth order, in which four molecules of substances are undergoing change, e.g.



**Reactions, Quinquemolecular.** (Pentamolecular reactions.) Reactions of the fifth order. Reactions in which five molecules are undergoing simultaneous transformation, e.g. the reaction between potassium ferricyanide and iodide.

**Reactions, Unimolecular.** (Monomolecular reactions.) Reactions of the first order. Reactions in which one molecule only is undergoing chemical change, e.g. the decomposition of hydriodic acid by light, the conversions of synaldoximes into the anti forms, etc. According to the mass law the velocity of unimolecular reactions is given by the expression,

$$\frac{dx}{dt} = k(a - x),$$

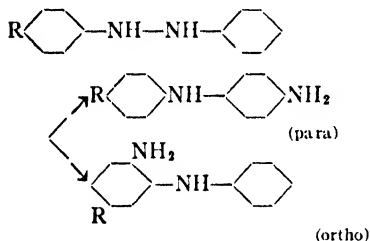
which, on integration, becomes

$$\frac{1}{t_2 - t_1} \log \frac{a - x_1}{a - x_2} = k,$$

where  $a$  = the initial concentration of substance changed, and  $x_1$  and  $x_2$  = the

amounts of substance changed in time  $t_1$  and  $t_2$ .

**Rearrangement, Semidine.** (Semidine conversion or transformation.) A special case of the benzidine rearrangement which occurs when one of the benzene nuclei in an hydrazo-benzene is substituted in the para position so that but one  $\text{—NH—}$  group is converted into  $\text{—NH}_2$ , i.e. but one benzene nucleus is rearranged. In rare cases the substituent is split out and the benzidine rearrangement takes place, a diphenyl base is formed, or the molecule is split and two benzene bases result. The semidines which result from the normal rearrangement are named ortho or para according to the position of the amino group, viz.,



**Réaumur.** A degree on the réaumur thermometric scale; see thermometer.

**Recarbonize.** To restore a content of carbon, as to recarbonize iron to make steel.

**Reciprocal Ohm.** The mho, q.v.

**Recrystallize.** To subject to repeated crystallization in order to purify. The process is termed recrystallization.

**Rectification.** The purification of crude alcoholic distillates by fractional distillation whereby aldehydes, esters, acids, and fusel oils together with most of the water are gotten rid of.

**Rectify.** To submit to the process of rectification.

**Recuperative Heating.** The counter current flow of hot combustion gases from a furnace through flues on the other side of which cold gases pass to the furnace. This method avoids intermixture of incoming and outgoing gases.

**Red Liquor.** A solution of aluminium acetate in dilute acetic acid used in dyeing.

**Red Oil.** Commercial oleic acid.

**Reduce.** To submit to a process of reduction; see reduction.

**Reduced Characteristic Equation.** (Reduced equation of condition.) An equation of condition which holds for all liquids and gases, viz.,

$$\left(\pi + \frac{3}{\phi^2}\right)(3\phi - 1) = 8\theta,$$

where,  $\pi$  = critical pressure,  $\phi$  = critical volume,  $\theta$  = critical temperature.

**Reducer.** } A compound, element, or force, which is capable of effecting a reduction reaction under the proper conditions. Hydrogen, hydriodic acid, stannous chloride, ferrous chloride, dextrose, iron, ammonium sulphide, sodium amalgam, electricity, and light, are among the common reducing agents.

**Reductases.** Enzymes which catalyze reduction reactions. No member of this class has yet been isolated.

**Reduction.** 1. Addition of hydrogen to or subtraction of oxygen from a substance. 2. Lowering the valence of an element in combination, as reducing ferric chloride to ferrous chloride. 3. In metallurgy reduction implies a process which liberates an element from its ore, especially from an oxide. Note: All reductions are accompanied by a concomitant oxidation. Cf. oxidation.

**Reflection Wave.** A wave of compression sent back through the burnt gas when an explosion wave is completely or partially stopped against a closed extremity or constricted portion of a tube.

**Reflux Condenser.** An ordinary condenser set so that the condensed vapor will flow back into the vessel which contains the boiling mixture. A device to prevent evaporation during a heating process.

**Refraction, Atomic.** The refractive power of an atom calculated from the refractive powers of its compounds.

**Refraction, Index of.** A constant characteristic of a substance at a definite temperature. The ratio of the sine of the angle of an incident ray of light to the sine of the angle of the refracted ray.

**Refractive Power, Molecular.** The product of the molecular weight of a substance into its specific refractive power.

**Refractive Power, Specific.** A property of liquids depending on the index of refraction and the density. The specific refractive constant is expressed by  $n - 1/d$  or  $(n - 1)v$ , which varies with the temperature, or by

$$\frac{n^2 - 1}{n^2 + 2}v,$$

which is independent of temperature and state of aggregation, where  $n$  = refractive index,  $d$  = density, and  $v$  = specific volume.

**Refractometer.** An instrument for determining the refractive index of a substance.

**Regelation.** The phenomenon which occurs when two pieces of ice are rubbed together, the pressure causing the ice to melt at the surfaces of contact while the temperature drops, and,

on relieving the pressure, the two surfaces freeze together, producing one mass of ice.

**Regenerative Furnace.** A furnace equipped with "checkerwork" chambers for regenerative heating.

**Regenerative Heating.** The pre-heating of fuel gases by passing them alternately through two "checkerwork" chambers which have been heated with the waste gases from the furnace in such a way that the waste gases are heating one series of chambers while the fuel gases are being heated in the other. When the second series of chambers has been cooled the fuel gas and waste gases are shifted so that the fuel gas passes through the chambers which have just been heated and the waste gases pass through and heat the cooled chambers.

**Relative Weight.** The atomic weight.

**Reniform.** (bot.) Kidney-shaped.

**Replaceable.** An atom or radical in a compound for which another atom or radical may be directly substituted, e.g. benzene has six replaceable hydrogen atoms. Acetic acid has one hydrogen atom replaceable by a metal and three replaceable by halogens.

**Replace.** To substitute one atom or radical for another atom or radical in any compound, especially in carbon compounds.

**Residue.** 1. The insoluble matter left on a filter or from which a liquid has been decanted. 2. A radical or a group, especially in carbon compounds.

**Resins.** Mixtures of oxygen derivatives of cyclic hydrocarbons, resin acids and phenolic derivatives. Resins are characterized by lack of crystalline structure, low melting point, insolubility in water, solubility in alkalis, alcohol, and most organic

solvents. On fusion with alkalis resins yield benzene phenols (resorcin, phloroglucin, etc.), and on distillation with zinc dust they yield benzene, naphthalene, and similar hydrocarbons. Cf. gum-resins.

**Resistance, External.** The resistance of that part of the electric circuit which lies outside the source of the current, e.g. the resistance of a wire stretched from one pole of a cell to the other.

**Resistance, Internal.** The resistance within the apparatus which is generating an electric current, e.g. in a cell, the resistance of the electrodes and the electrolyte solutions.

**Resistance, Specific.** } A proportion-  
**Resistivity.** } ality factor  
 characteristic of different substances equal to the resistance a centimeter cube of the substance offers to the passage of a current of electricity, or  $\rho = Ra/l$  where  $R$  = resistance,  $a$  = cross section, and  $l$  = length.

**Resists.** In textile printing, substances printed on the cloth to prevent access of dye or mordant to certain portions.

**Respiratory Quotient.** The ratio of the volume of expired carbon dioxide to the volume of inspired oxygen, or  $\text{CO}_2/\text{O}_2$ . The ratio is generally less than 1 due to the volume of expired carbon dioxide being less than the volume of inspired oxygen.

**Resultants.** The products of a reaction.

**Retardation, Catalytic.** Negative catalysis.

**Reticulate.** (bot.) Net-veined, net-formed.

**Retregression (of Ionization).** The reversal of ionization which occurs when a compound is added to a solution

of a second compound with which it has a common ion, the volume being kept constant. The degree of ionization of the second compound is lowered, i.e. it retrogresses.

**Retrogressive Substitution.** See substitution.

**Reverberatory Furnace.** A furnace with a low sloping roof used for calcination, etc., where the flames but not the fuel come in contact with the material to be calcined. The flames are deflected downward onto the material by the sloping roof.

**Revive.** To restore to its original or natural state, as to revive a metal from one of its salts, or to restore worn out animal charcoal to a state of activity. Also used in the sense of restoring a catalyst to its original activity. The process is termed revivification.

**Rhamno-Galactosides.** Glucosides which, on hydrolysis, yield rhamnose and galactose, as robinin and xanthorhamnin.

**Rhamno-Glucosides.** Glucosides which, on hydrolysis, yield rhamnose and glucose, as hesperidin, rutin, sophorin.

**Rhamno-Mannosides.** Glucosides which yield rhamnose and mannose on hydrolysis, as strophanthin.

**Rhamnosides.** Glucosides which yield rhamnose upon hydrolysis, as quercitin, baptisin, frangulin, etc.

**Rheometer.** A galvanometer.

**Rheostat.** An instrument used to control the resistance through which an electric current must pass. It therefore furnishes a means of controlling the amount of current according to Ohm's law.

**Rhizome.** (bot.) An underground stem or rootstock.

**Rhodium.** Metallic element. Rh. At. Wt. 102.9. S. G. 12.1. S. heat 0.05803. M. P. 1650–2000°. Occurs in platinum ores. Valence 3. Oxides RhO, Rh<sub>2</sub>O<sub>3</sub>, RhO<sub>2</sub>. Rhodium sulphate forms a series of alums with the alkali metals.

**Ring.** (Atomic ring.) A collection of atoms arranged in a ring, as the benzene ring, pyridine ring, etc. Ring-shaped compounds are termed cyclic.

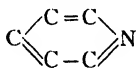
**Ring, Benzene.** A homocyclic six membered ring designed to represent the structure of benzene; see benzene.

**Ring, Heterocyclic.** A ring which contains more than one kind of atom, as the pyridine ring (N and C), lactone ring (C and O), thiophene (C and S), betaine (C, N, and O) and diazophilide (C, N, and S).

**Ring, Homocyclic.** A ring in which all of the members are atoms of the same element.

**Ring, Naphthalene.** The atomic complex which represents the structure of naphthalene, see naphthalene.

**Ring, Pyridine.** An heterocyclic ring in which nitrogen takes the place of one of the carbons in benzene, thus



**Roasting.** Firing, calcining.

**Rotate.** To turn the plane of polarized light either to the right or left.

**Rotation, Magnetic.** Optical activity developed in a liquid when placed between the poles of a magnet. Specific magnetic rotation is the ratio of the specific rotation of the substance to that of water under like conditions. The molecular magnetic rotation is calculated by multiplying the specific magnetic rotation by the molecular

weight and dividing by the molecular weight of water.

**Rotation, Molecular.** The product of the specific rotation into the molecular weight.

**Rotation, Specific.** (a) The rotation caused by a substance when it is in the concentration of one gram per cubic centimeter of solution when the polarized light is passed through a layer one centimeter in length. This is given by the formula,

$$[\alpha]_D^t = \frac{a}{l \cdot d},$$

where  $a$  is the angle of rotation,  $l$  the length, in centimeters, of the liquid through which the light passes,  $d$  the weight, in grams, of substance in one cc. and  $t$  = temperature. D = sodium light (D line of spectrum), the light usually used.

**Rotatory.** Optically active. Capable of rotating the ray of polarized light, distinguished as dextro-rotatory and laevo-rotatory.

**Rotatory Power.** The extent to which a substance rotates the ray of polarized light is its rotatory power.

**Rotatory Power, Specific.** See rotation, specific.

**Rotatory Reflection.** A method for securing superposition in crystals of 2, 4, or 6-fold axes, consisting of rotation around an axis followed by reflection in a plane normal to the axis of rotation.

**Rubidic.** Containing rubidium.

**Rubidium.** Metallic element. Rb. At. Wt. 85.45. S. G. 1.532. M. P. 38.5°. Valence 1. Occurs in lepidolite, triphylite, mineral waters, etc. Oxide Rb<sub>2</sub>O.

**Rugose.** (bot.) Wrinkled.



**Rule of Crum-Brown and Gibson.** In substitution, in the aromatic series, if the substituent already present forms with hydrogen a compound which can be converted by direct oxidation into the corresponding hydroxyl compound, the new substituent will enter the meta position; otherwise it will enter the ortho-para position.

**Ruthenic.** Compounds of ruthenium in which that metal is quadrivalent.

**Ruthenious.** Compounds of ruthenium in which that metal is trivalent.

**Ruthenium.** Metallic element. Ru. At. Wt. 101.7. S. G. 12.26 (cryst.). S. heat, 0.0611. M. P. 2000°. Occurs in platinum ores. Oxides,  $\text{Ru}_2\text{O}_3$ ,  $\text{RuO}_2$ ,  $\text{RuO}_4$ . Valence 2, 3, and 4. Acids, ruthenic,  $\text{H}_2\text{RuO}_4$ , and perruthenic,  $\text{HRuO}_4$ , known in their salts.

## S.

**Saccharification.** Converting into or impregnating with sugar, especially the malting of grains.

**Saccharify.** To convert into or impregnate with sugar or a sugar, especially to convert starches into maltose, as in the malting of grains.

**Saccharimeter.** 1. A polariscope graduated to read directly in percentage of sugar (saccharose). 2. A fermentation tube designed to indicate the amount of sugar in a given sample by measuring the volume of carbon dioxide evolved by its fermentation.

**Sagittate.** (bot.) Shaped like an arrow head.

**Sal.** A prefix which indicates a salt, as in sal-ammoniac.

**Salify.** To convert into a salt, as to salify a base. Substances which can react to form salts are termed salifiable and the process is known as salification.

**Saline.** Of, pertaining to, or containing a salt. Of the nature of a salt; salty, as saline substances, saline springs, etc.

**Salt.** A compound formed by replacement of the hydrogen of an acid by an element or a radical which is essentially inorganic. Alkaloids, amines, pyridines and other basic organic substances may be regarded as substituted ammonias in this connection. The halogen derivatives of hydrocarbon radicals and the esters are not regarded as salts in the strict definition of the term. A list of the varieties of salts follows:

**Salt Acid.** Hydrochloric acid.

**Salt, Acid.** A salt in which all the replaceable hydrogen of the acid has not been substituted by a radical or element. These salts, in ionizing, yield hydrogen ions and react like the acids. E.g.  $\text{NaHSO}_4$ ,  $\text{KHCO}_3$ ,  $\text{Na}_2\text{HPO}_4$ .

**Salt, Alkaline.** (Basic salt.) A salt which contains combined base as  $\text{Pb(OH).Pb(C}_2\text{H}_3\text{O}_2)_2$  a basic acetate of lead. They may be regarded as formed from basic hydroxides by partial replacement of hydroxyl, e.g.  $\text{HO—Zn—Cl}$ . They react like bases and, when soluble, ionize to form hydroxyl ions.

**Salt, Amphid.** An old term for an oxy salt regarded as formed from two oxides, one of which is acid and the other basic, e.g.  $\text{K}_2\text{O.SO}_3$ . (Obs.)

**Salt, Basic.** See salt, alkaline.

**Salt, Binary.** 1. A double salt, q.v. 2. An oxy salt regarded as composed of two components, e.g. a metal and an acid radical. (Obs.)

**Salt Cake.** Crude sodium sulphate resulting from the action of sulphuric acid on sodium chloride.

**Salt, Complex.** A saline compound formed by the combination of two or more salts and which is regarded as the normal salt of a complex acid. They do not split into a mixture of the constituent salts in solution but furnish a complex ion which contains one of the bases, e.g. potassium ferrocyanide, and potassium platinochloride.

**Salt, Double.** (Binary salt.) Two simple salts which crystallize together in definite proportions but exist independently in solution (distinction from complex salts). The alums are representative double salts.

**Salt, Essential.** A salt obtained by evaporating plant juices. (Obs.)

**Salt, Haloid.** Any salt of an hydrohaloid acid, e.g. the chloride, bromide, iodide, or fluoride of any base.

**Salt, Neutral.** Neither alkaline nor acid in nature. A normal salt.

**Salt, Normal.** (Neutral salt.) A salt in which the acid has been exactly neutralized by the base, as  $KCl$ ,  $Na_2CO_3$ ,  $BaSO_4$ .

**Salt, Oxy.** A salt of an oxygen-containing acid, as  $KClO_3$ .

**Salt, Per.** A salt supposed to be derived from a peroxide base. (Obs.)

**Salt, Proto.** A salt derived from a protoxide. (Obs.)

**Salt, Sesqui.** A salt derived from a sesquioxide, e.g.  $Fe_2(SO_4)_3$ . (Obs.)

**Salt, Sulpho.** A salt of a sulpho acid.

**Salting Out.** Precipitating a substance from solution by adding a soluble salt in the presence of which the substance is insoluble or much less soluble. Soaps are precipitated from aqueous solution by sodium chloride; many dyestuffs are insoluble in saline solutions and may be salted out; proteins may be separated by taking advantage of their varying solubility in saturated and partly saturated solutions of ammonium sulphate, sodium chloride, magnesium sulphate, and in pure water.

**Samarium.** Metallic element. Sm. At. Wt. 150.4. M. P. 1300–1400°.

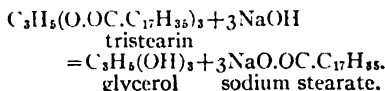
S. G. 7.7. Occurs in samarskite. Valence 2 and 3. Oxide,  $Sm_2O_3$ .

**Sandmeyer's Reaction.** See reaction, Sandmeyer's.

**Sand Bath.** A contrivance to secure even, regulated heating in which the vessel which contains the material to be heated is placed in a mass of ordinary coarse sand in a suitable (iron) container. The direct heat is applied to the sand which transmits it evenly to the reaction vessel.

**Sapiphores.** According to Sternberg atomic groups which bear to taste the same relation that an harmonic chord does to hearing. Substances which contain these groups are sweet.

**Saponification.** The hydrolysis of an ester by an alkali so that a free alcohol and an alkali salt of the ester acid result. The term was formerly restricted to the alkaline hydrolysis of fats whereby a soap is formed but has been extended to include a variety of hydrolyses, even those of alkyl esters of inorganic acids and hydrolysis by superheated steam. A characteristic case of saponification is the action of caustic soda on tristearin:



**Saponification Equivalent.** The number of grams of a fat which would be saponified by one liter of normal alkali. It may be calculated from the saponification number: Sap. equiv. = 56108 / sapon. number.

**Saponification Number.** (Koettstorfer number.) The number of milligrams of potassium hydroxide consumed in the complete saponification of one gram of a fat or wax. A constant of a fat or wax.

**Saponins.** A class of glucosidal substances of high molecular weight characterized by 1. solubility in water and slight solubility in cold alcohol, 2. a persistent foaming of their aqueous solutions, 3. giving a greenish coloration with ferric chloride in the presence of alcoholic sulphuric acid, 4. production of strong irritation of mucous membranes, 5. producing hemolysis in the blood stream. They occur naturally in plants, e.g. *Quillaja saponaria*.

**Saturable.** Capable of being saturated.

**Saturate.** 1. To dissolve in a solvent all of a solute which the solvent can absorb at the given temperature. 2. To dissolve under conditions as in 1. a gas in a solution of some compound which combines with it, as to saturate aqueous sodium hydroxide with hydrogen sulphide. 3. To cause a reaction to take place whereby one compound is completely converted into a product, as to saturate an acid with a base. 4. To neutralize. 5. To reduce completely an unsaturated compound, as to convert acetylene into ethane. The saturating agent may be called the saturant. The process is termed saturation.

**Saturated Compounds.** Organic compounds in which each carbon valency is combined with a distinct atom, except that double or poly-linkages between carbon and certain other elements (particularly nitrogen) do not cause unsaturation. If a carbon compound cannot be made to add hydrogen without splitting it may be regarded as saturated.

**Saturated Hydrocarbons.** A name applied to the paraffin hydrocarbons, although any hydrocarbon which does not contain a double or triple bond is saturated.

**Saturated Solution.** A system consisting of a solvent and solute in equilibrium in which the proportion of

solute to solvent is the maximum possible at the given temperature and under the condition of equilibrium.

**Saturation Current.** The maximum current which will pass through a gas under definite conditions of ionization. It is a measure of the charge carried by the ions produced in each second and hence may be used as a measure of the radioactivity of a substance.

**Scabrous.** (bot.) Rough.

**Scandium.** Metallic element. Sc. At. Wt. 44.1. Valence 3. Oxide  $\text{Sc}_2\text{O}_3$ . Occurs in euxenite.

**Scheelium.** An old name for tungsten.

**Scission.** A splitting or dividing of a molecule, especially the splitting off of one carbon from a chain.

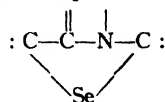
**Sclero-Proteins.** Proteins which form the skeletal structure of animals, see proteins.

**Second Law.** (Second law of energy, of energetics, of thermodynamics.) See law of degradation of energy.

**Secondary.** A term applied to one class of compounds or actions to distinguish it from other generically similar compounds or actions termed primary, tertiary, quaternary, etc. In organic chemistry compounds which may be regarded as di-derivatives of the parent substance are often termed secondary. See secondary reactions, secondary alcohols, amines, bases, battery, etc.

**Seed.** (bot.) A ripened ovule.

**Selenazol Group.** The complex,



Cf. thiazole group.

**Selenium.** Non-metallic element. Se. At. Wt. 79.2. Mol. Wt. 633.6. Occurs in three allotropic forms, monoclinic, hexagonal, and amorphous. Found in clausenthalite, silver selenide, copper selenide, etc. Valence, 2 and 4 (6). Oxide  $\text{SeO}_2$ . Acids,  $\text{H}_2\text{Se}$ ,  $\text{H}_2\text{SeO}_3$ ,  $\text{H}_2\text{SeO}_4$ .

**Selenic.** Compounds of selenium in which it has a valence of four.

**Selenious.** Compounds of selenium in which it has a valence of two.

**Selenuretted.** Combined with selenium, as in a selenide. (Obs.)

**Selenyl.** The radical  $\text{SeO}$ .

**Semi-.** A prefix which indicates "half" and also "imperfectly."

**Semidines, Ortho and Para.** See rearrangement, semidine.

**Semidine Rearrangement.** (Semidine conversion, semidine transposition.) See rearrangement, semidine.

**Semi-Metal.** See metal.

**Semi-Permeable Membrane.** (Semi-permeable diaphragm.) A membrane or septum through which a solvent but not certain dissolved substances may pass, used in osmotic pressure determinations. Many natural membranes are semi-permeable, e.g. cell walls; other membranes may be made artificially, e.g. by precipitating copper ferrocyanide in the interstices of a porous cup, the cup serving as a frame to give the membrane stability. Cf. osmotic pressure.

**Sensitization.** The process of rendering susceptible to the action of some force or state, as radiant energy, acidity, etc.

**Sepal.** (bot.) A division of the calyx of a flower.

**Septum.** A wall or partition separating two cavities.

**Serrate.** (bot.) Having teeth which point forward.

**Sesqui-.** A prefix which indicates a proportion of two to three, as a sesquioxide in which the atomic proportions of metal and oxygen are as two to three, e.g.  $\text{Fe}_2\text{O}_3$ . The term is also used to indicate "half." Cf. subse-qui-.

**Sesquioxide.** An oxide in which the ratio of metal to oxygen is as two to three, as in ferric oxide, aluminic oxide, etc.

**Sesquiterpenes.** Terpenes of the formula  $\text{C}_{15}\text{H}_{24}$  as distinguished from the ordinary terpenes  $\text{C}_{10}\text{H}_{16}$ .

**Sessile.** (bot.) Without foot-stalk or petiole.

**Shrub.** (bot.) A perennial plant with a woody stem and smaller than a tree.

**Silicic.** Pertaining to or containing silicon or silica, as silicic acid.

**Silico-.** A combining term indicating content of silica.

**Silicon.** (Silicium.) Non-metallic element. Si. At. Wt. 28.3. Exists in two allotropic forms, amorphous and crystalline. Amp. S. G. 2.00. S. heat 0.214. Cryst. S. G. 2.49. S. heat 0.1697. M. P. 1200°. B. P. 3500°. Valence 4. Occurs in quartz, tridymite, and nearly all rocks. Oxide,  $\text{SiO}_2$ . Acids, orthosilicic,  $\text{Si}(\text{OH})_4$ ; metasilicic,  $\text{H}_2\text{SiO}_3$ .

**Silvanium.** See sylvanum.

**Silver.** (Argentum.) Metallic element. Ag. At. Wt. 107.88. S. G. 10.53. S. heat 0.0559. M. P. 861.5°. B. P. 2050°. Valence 1. Occurs native, in argentite, pyrargyrite,

chlorargyrite (horn silver), etc. Oxides,  $\text{Ag}_2\text{O}$ ,  $\text{Ag}_2\text{O}_2$ .

**Simple.** 1. Elementary. 2. Not complex, as a simple ether.

**Skeleton.** The framework which indicates the atomic structure of a compound or a class of compounds. The benzene ring is the skeleton of aromatic compounds. (Cf. nucleus.)

**Skraup's Synthesis.** See reaction, Skraup's.

**Soap.** A metallic salt of one of the higher fatty acids or a mixture of such salts. The true soaps are salts of the alkali metals and are soluble in water but the term has been extended to include the salts of other metals, some of which are insoluble in water. Rosin soaps are metallic salts of resin acids.

**Soda.** Sodium carbonate. Caustic soda is sodium hydroxide.

**Sodaic.**  
**Sodic.** } Containing or pertaining  
**Sodio-** } to the metal sodium.

**Sodium.** (Natrium.) Metallic element. Na. At. Wt. 23.00. S. G. 0.9735. S. heat 0.2934. M. P.  $97.6^\circ$ . B. P.  $877.5^\circ$ . Valence 1. Occurs in sea water, rock salt, cryolite, borax, etc. Oxides,  $\text{Na}_2\text{O}$ ,  $\text{Na}_2\text{O}_2$ .

**Sodyl.** The radical  $\text{NaO}$  as in  $\text{NaO.OH}$ . (Obs.)

**Sol.** A colloidal solution in which the system is apparently liquid. If water is the continuous phase the system is termed an hydrosol.

**Solation.** In colloidal nomenclature, the process of change from a gel to a sol. The gel is said to solate.

**Solid.** A state of aggregation in which the substance possesses both definite volume and definite shape. Solids possess elasticity both of shape and bulk, that is, they resist any

force which tends to alter their volume or form. Solids are characterized by very stable surfaces of distinct outline on all sides.

**Solidify.** To become solid. To change from the gaseous or liquid to the solid state.

**Solubility.** A property of a substance by virtue of which it forms mixtures with other substances which are chemically and physically homogeneous throughout. The degree of solubility (often spoken of as "solubility") is the concentration of a solute in a saturated solution at any given temperature. The degree of solubility of most substances increases with rise in temperature, but there are many cases (notably the organic salts of calcium) where a substance is more soluble in cold than in hot solvents.

**Solubility, Apparent.** The total amount of salt present in unit volume of a solution, see solubility, real.

**Solubility Product.** A numerical quantity dependent upon temperature and solvent, characteristic of electrolytes. It is the product of the concentration of the ions in a saturated solution and defines the degree of solubility of the substance. When the product of the ion concentrations exceeds the solubility product precipitation results.

**Solubility, Real.** The amount of non-ionized salt which exists in unit volume of a solution, as distinguished from "apparent" solubility.

**Solubility, Retrograde.** Solubility which decreases with rise in temperature, as that of sodium sulphate above  $34^\circ$ , and that of many organic calcium salts.

**Solute.** The dissolved substance in a solution.

**Solutides.** True solutions.

**Solution.** A homogeneous mixture of substances which forms a single phase. Gases are all mutually soluble in all proportions; liquids dissolve gases, other liquids, and solids; and solutions of solids in solids are known.

**Solution, Anisotonic.** An hypo- or an hypertonic solution; see isotonic.

**Solution, Colloidal.** (Disperse systems.) Heterogeneous systems consisting of more than one phase. The solvent is termed the continuous phase and the suspended matter the disperse phase. This disperse phase exists in minute particles each of which is many times larger than the molecule (a distinction from a true solution). If the disperse phase is a solid the system is termed an emulsoid; if liquid, an emulsoid or emulsion (if the particles of disperse phase are quite large).

**Solution, Heat of.** (L.) The heat absorbed or evolved when a substance is dissolved in a solvent. The value varies with the concentration and, in some instances, the sign of the value may be reversed. The value usually given refers to the solution of one gram of substance in a large quantity of solvent. This includes the heats of dilution, hydration, and ionization, e.g. the heat of solution of KOH is +12,500 cal. and that of  $\text{KOH} \cdot 2\text{H}_2\text{O}$ , is -30 cal.

**Solution, Isohydic.** See isohydic solutions.

**Solution, Isotonic.** A solution which exhibits the same osmotic pressure as some other solution, some physiological liquid, or some living cells with which it is compared. Hypertonic solutions and hypotonic solutions show higher and lower osmotic pressures, respectively, than isotonic solutions. Cf. plasmolysis.

**Solution, Normal.** (Volumetric solution.) A solution used in volumetric

analysis which contains a definite quantity of solute per liter. 1. Molar normal solutions contain one gram-molecule of solute per liter. 2. Equivalent normal solutions (the ordinary volumetric solutions) contain one gram of hydrogen or its equivalent per liter at 17° or 20°. Derived terms are decinormal solution, hundredth normal solutions, etc.

**Solution Pressure.** The force with which a substance tends to dissolve, equal to the osmotic pressure of its saturated solution (for this is the opposing force which determines equilibrium).

**Solution Pressure, Electrolytic.** The force with which an ion tends to go into solution, equal to the opposing osmotic pressure plus the opposing force of the electrical charges.

**Solution, Singular.** A solution whose vapor pressure curve shows a maximum or minimum indicating the formation of a constant boiling mixture, as aqueous solutions of alcohol.

**Solution, Solid.** A solid homogeneous complex of several substances the proportions of which may vary without affecting the homogeneity of the solution. (van't Hoff.) Isomorphous mixtures are solid solutions.

**Solution, Standard.** Any solution of known, definite concentration. Cf. solution, normal.

**Solution, Standardized.** A solution adjusted to contain a definite known concentration of solute.

**Solution, Supersaturated.** A solution which contains a greater quantity of dissolved solute than that which can exist at the given temperature in contact with the solid solute. Supersaturated solutions are metastable systems in which a true equilibrium is not established. Addition of solid

substance, stirring, friction, etc., cause the separation of the excess of solute.

**Solution Volume.** See molecular solution volume.

**Soluble.** Soluble.

**Solvate.** The complex supposed to be formed by solvation.

**Solvation.** The assumed formation of a complex between solute and solvent in solutions under certain circumstances.

**Solvent.** The dissolver. That component of a system which furnishes the medium for the dispersion of the dissolved molecules. In cases of solutions of solids in solids, liquids in liquids, and gases in gases, either component may be regarded as solvent. With solutions of solids or gases in liquids the liquid is usually regarded as the solvent.

**Sorbed.** See sorption.

**Sørensen's Nomenclature.** See hydrogen ion concentration.

**Sorption.** The chemical or physical combination of water or similar substance within a curd, colloid, or coagulum as distinguished from "enmeshed" water.

**Specific Conductivity.** See conductivity, specific.

**Specific Gravity.** (S.G.) The ratio between the density of a substance and the density of some substance assumed as standard. For liquids and solids the standard assumed is the density of distilled water at 4° C. For gases the standards are air, hydrogen, or oxygen at 0° and 760 mm. or distilled water at 4°. The specific gravity is a relative property which varies with the temperature.

S.G. absolute alcohol, = 0.7851.  
chloroform, = 1.416.  
ether, = 0.7111.  
methylene iodide, = 3.3326.

**Specific Heat.** (s.) The ratio of the thermal capacity of a substance to that of water, numerically equal to the thermal capacity. Two figures are obtained for the specific heat of any gas according to whether the volume or the pressure is kept constant during the determination. The specific heat at constant pressure is greater by the amount needed to produce expansion. The ratio between the specific heats may be accurately determined by ascertaining the velocity of sound in the gas.

**Specific Heat, "True."** The specific heat of a gas determined at constant volume.

**Specific Resistance.** See resistivity.

**Specific Volume.** The volume which contains unit mass of a substance, i.e. the reciprocal of the density of the substance. Unit specific volume is a volume of one cubic centimeter per gram mass.

**Specific Weight.** Specific gravity.

**Spectrology.** Spectrum analysis.

**Spectroscopy.** The art of using the spectroscope.

**Spectrum.** A phenomenon produced by separating radiant energy (usually light) into its component wave-lengths by refraction through a prism, by diffraction by a grating, or by other means. Many spectra are partly invisible to the human eye.

**Spectrum, Absorption.** The spectrum produced by white light after it has passed through a medium which has the power to block the passage of waves of certain wave-lengths. These



waves are termed absorbed and are characteristic of the medium.

**Spectrum Analysis.** See analysis.

**Spectrum, Continuous.** The spectrum of white light which contains all the colors from red to violet and shows no discontinuities at any point. The spectra from incandescent bodies, molten metals, and incandescent lamps are continuous.

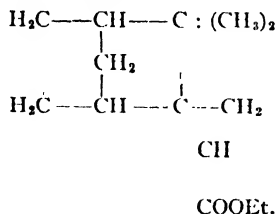
**Spectrum, Diffraction.** (Normal spectrum.) The spectrum produced by a diffraction grating.

**Spectrum, Normal.** A term applied to the diffraction spectrum, q.v.

**Sphere of Attraction of Molecular Forces.** The distance within which the mutual attraction of the molecules begins to have a "noticeable value."

**Spirit.** 1. (Cologne spirit. Spirit of wine. S.V.R. Spiritus vini rectificatus.) Ethyl alcohol. "Proof spirit" in the United States is an alcoholic liquor which contains one half its volume of alcohol of a S.G. of 0.7939 at 60° F. English proof spirit contains 49.24% absolute alcohol by weight. 2. In pharmacy, an alcoholic solution of a volatile substance.

**Spiro Derivative.** A derivative of an R-hexane in which one of the ring carbons is a member also of a trimethylene ring, e.g.



The spiro grouping is enclosed in the dotted lines.

**Splitting.** (Scission.) The chemical division of a molecule into two or more new molecules, especially in "lysis" processes as hydrolysis, alcoholysis, saponification, etc.

**Spongy Platinum.** Finely divided, porous platinum, frequently employed as a catalytic agent in oxidation reactions on account of its ability to condense large quantities of oxygen. It may be prepared by gently heating ammonium chlor-platinate.

**Spontaneous.** Occurring by virtue of inherent properties or energy as distinguished from processes carried out by deliberate application of external force, as spontaneous evaporation, combustion, oxidation, etc.

**Spontaneous Disintegration of Matter, Theory of.** In each second a small number of the atoms of radioactive material become unstable and break up with explosive violence, the change being accompanied by the expulsion of an  $\alpha$  or  $\beta$  particle or both.

**Sprengel Pump.** A form of mercury pump used to obtain high vacuums.

**Stalagmometer.** An instrument for measuring surface tension.

**Stamen.** (bot.) The pollen-bearing organ of a flower.

**Standard Cell.** See cell, cadmium and Clarke's.

**Standard Gas.** Oxygen.

**Stannic.** A salt on tin in which that metal is quadrivalent. The corresponding combining term is "stanni."

**Stanno-.** A prefix which indicates divalent tin.

**Stannoso-.** Same as stanno-.

**Stannous.** A salt of tin in which that metal is divalent.

**Stannum.** Latin name of tin.

**State.** Condition. In science, usually refers to the state of aggregation.

**State, Nascent.** See nascent.

**Statmetric.** } See analysis,  
**Stathmetometric.** } quantitative.

**Steam.** 1. Water vapor, especially when at a temperature at or above the boiling point of water. 2. By analogy, the vapor of any liquid at or above the boiling point of the liquid.

**Stearoptene.** A solid constituent of an essential oil, the liquid portion of the oil being known as the eleoptene. Thymol is the stearoptene of the oil of *Thymus vulgaris*; menthol the stearoptene of oil of peppermint.

**Steel.** A kind of iron that is malleable at certain temperatures and may be tempered. Sometimes regarded as a compound of iron and carbon. Its carbon content varies from nearly zero to over two percent, but ordinarily does not run above 1.5%. Steels are distinguished as Bessemer, cementation, open-hearth and crucible according to the method of manufacture. Mild steels contain less than 0.2% of carbon. Special steels are produced by adding small amounts of chromium, nickel, molybdenum, tungsten, manganese, vanadium, etc., to the molten metal.

**Stere.** A unit of atomic volume. Its value lies between 6.7 and 7.4. It is assumed that the atomic volumes are multiples of this unit or are equal to it.

**Stereo-** A prefix which indicates "solid" or "three-dimensional."

**Stereochemistry.** (Spacial chemistry.) A branch of chemistry which investigates the phenomena considered to be due to the relative positions in

space assumed by atoms within the molecule, i.e. due to the configuration of the compound.

**Stereoisomerism.** Isomerism due to stereochemical differences.

**Stereoisomers.** Isomers which differ only in the relative spacial positions of their constituent atoms. See isomerism, optical and geometric.

**Sterols.** A group of the "lipins." Sterols are solid alcohols like cholesterol, the phytosterols, cetyl alcohol, myricyl alcohol, etc. There is no necessity for this classification.

**Stibic.** A compound which contains pentavalent antimony.

**Stibonic.** A salt of stibine.

**Stibonium.** Compounds of stibine,  $\text{SbH}_3$ , analogous to the ammonium salts.

**Stibious.** A compound which contains trivalent antimony.

**Stibium.** Latin name for antimony.

**Still.** An apparatus for conducting distillation. It consists of the still proper (evaporator, vaporizer) which is a vessel of refractory materials used to contain the mixture to be vaporized, a condenser, to liquefy the vapors, and a receiver to collect the distillate. Other appliances, such as fractionating columns, preheaters, dephlators, etc., are frequently incorporated in the apparatus. A vacuum still is a form of this apparatus constructed especially to allow distillation to be conducted under reduced pressure and to withstand enormous (external) air pressure.

**Stoichiometry.** (Stoicheiometry.) The art which deals with the numerical relationships of chemical elements and compounds and the mathematical phenomena of chemical transformations. The mathematics of chemistry.

**Strain Theory.** An explanation of the varying stability of tri, tetra, penta, and hexa-methylene rings based on the assumption that the four valencies of carbon act in lines which connect the center of a sphere with the solid angles of a regular tetrahedron inscribed within it, hence forming angles of  $109^{\circ} 28'$  with each other. When two or more carbon atoms combine doubly as in ethylene,  $\text{CH}_2=\text{CH}_2$ , a strain in the valence lines is produced which, in ring compounds (ring strain), varies with the number of carbons in the ring. The greater the ring strain the less stable the ring.

**Strontic.** } Pertaining to com-  
**Strontitic.** } pounds of strontium.

**Strontium.** Metallic element. Sr. At. Wt. 87.63. S. G. 2.54. M. P.  $900^{\circ}$ . Valence 2. Occurs in celestine and strontianite. Oxides,  $\text{SrO}$  and  $\text{SrO}_2$ .

**Structural Theory.** Any theory of the constitution of chemical compounds.

**Structure of Chemical Compounds.** See constitution, configuration.

**Sub-.** A prefix indicating "below" or "lower," especially of lower valence as in the term subchloride. Also used to indicate a basic salt as subsulphate, subnitrate, subcarbonate.

**Subacetate.** A basic acetate, as lead subacetate.

**Sub-Atom.** (Atomicule.) A term applied to any assumed component of an atom on the hypothesis that atoms are complex substances.

**Subatomic.** Pertaining to the chemistry of radioactive substances and their products.

**Subatomic Decomposition.** Radioactive elements disintegrate by subatomic decomposition, i.e. by the splitting of the atoms.

**Sublimate.** The condensed vapor from the process of sublimation, analogous to the distillate from distillation.

**Sublimation.** The transformation of a solid directly to the gaseous condition without passing through the liquid state. When the vapor pressure of a solid becomes greater than the atmospheric pressure the solid vaporizes completely at constant pressure. The temperature at the point where the vapor pressure of a solid equals the atmospheric pressure is its sublimation temperature. The  $t^{\circ}$  at which, under atmospheric pressure, the following sublime is:

crystalline arsenic,	$449.5^{\circ}$
carbon,	$3500^{\circ}$
arsenious oxide,	$125-150^{\circ}$

**Sublime.** To pass from the solid directly to the gaseous state without previously melting.

**Sublimation, Heat of.** The heat change in calories which occurs when one gram of solid is converted into a gas at the same temperature. The molar heat of sublimation is based on one gram-molecule, more rarely on one gram-equivalent.

**Submicron.** In Zsigmondy's nomenclature, submicrons are particles between  $5 \times 10^{-7}$  and  $10^{-5}$  cm. in diameter. Cf. millimicron.

**Sub-Molecules.** Ions.

**Suboxide.** An oxide which contains a smaller proportion of oxygen than some other (usually normal) oxide of the element in question, as lead suboxide,  $\text{Pb}_2\text{O}$ .

**Subsesqui-.** A prefix indicating combination in the proportion of two to three, particularly where the acidic radical is in the proportion of two. (Obsolete.) In "sesqui" compounds the acidic radical is in the proportion of three to two of base.

**Substance.** A term used to designate a pure chemical compound or a definite mixture of them. It is in no wise equivalent to the term "body" which refers to a definite mass of material, i.e. two different masses of the same substance would constitute two "bodies" but not two substances.

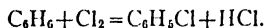
**Substantive Dyeing.** Dyeing fabrics with dyestuffs which do not require mordanting. See dyeing.

**Substantive Dyes.** Dyes which color fabrics directly without requiring previous mordanting. See dyes.

**Substitute.** To replace one element in a compound by another.

**Substituted Compounds.** A compound derived from a parent by substitution, e.g. toluol from benzene by substitution of methyl for hydrogen. Derivatives of this type are often spoken of as substituted-benzols, naphthalenes, phenols, amines, etc., according to the parent.

**Substitution.** The replacement of one element or group in a compound by another, e.g. in the preparation of chlorobenzene one atom of chlorine is substituted for one of hydrogen in benzene.



**Substitution, Retrogressive.** The replacing of substituents by hydrogen, i.e. the reverse of substitution where hydrogen is usually replaced.

**Substrate.** The substance modified by the action of an enzyme or by the growing upon it of microorganisms.

**Subsulphate.** A basic sulphate, e.g. mercury subsulphate,  $\text{HgSO}_4 \cdot 2\text{HgO}$ .

**Sucroclastic.** Glycolytic. See enzymes, sucroclastic.

**Sugar.** 1. Saccharose, cane or beet sugar. 2. A generic term for a class of carbohydrates characterized by solubility in water, a sweet taste, and crystallinity. Cf. carbohydrates.

**Sulph-Acids.** Sulphonic acids.

**Sulphamic Acids.** Organic sulphur acids of the general formula  $\text{R}_2\text{N}-\text{SO}_2-\text{OH}$ .

**Sulphamides.** Sulphine containing derivatives of the secondary amines, e.g. tetramethyl sulphamide,  $(\text{CH}_3)_2\text{N}-\text{SO}_2-\text{N}(\text{CH}_3)_2$ .

**Sulphate.** A salt or an ester of sulphuric acid, as sodium sulphate,  $\text{Na}_2\text{SO}_4$ , ethyl sulphate,  $(\text{C}_2\text{H}_5)_2\text{SO}_4$ .

**Sulphatoxide.** A sulphate.

**Sulphatoxygen.** A name for the sulphate radical, proposed by Graham.

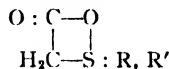
**Sulphazides.** Sulphone derivatives of hydrazo compounds of the general formula  $\text{R}-\text{NH.NH.SO}_2-\text{R}$ , e.g. phenylbenzenesulphazide,  $\text{C}_6\text{H}_5.\text{NH.NH.SO}_2.\text{C}_6\text{H}_5$ .

**Sulphides.** Salts of hydrosulphuric acid,  $\text{H}_2\text{S}$ , e.g. sodium sulphide,  $\text{Na}_2\text{S}$ . The inorganic acid sulphides,  $(\text{NaSH})$  are termed sulphhydrates; the organic compounds  $(\text{CH}_3\text{SH})$  being termed mercaptans.

**Sulphidic Sulphur.** Sulphur combined as salts of hydrosulphuric acid,  $\text{H}_2\text{S}$ , to distinguish it from sulphur in other combinations especially in organic mixtures.

**Sulphidion.** See sulphion.

**Sulphinates, Cyclic.** (Thetines.) Sulphur analogues of the betaines, e.g. compounds of the general formula,



**Sulphine Compounds.** (Sulphonium compounds.) Salts of alkyl sulphur derivatives in which the sulphur is tetravalent, e.g. trimethylsulphonium iodide,  $(\text{CH}_3)_3\text{S.I.}$

**Sulphinic Acids.** Mono alkyl esters of hydrosulphurous acid, e.g.  $\text{C}_2\text{H}_5\text{-O.S.OH.}$

**Sulphinoxide Carbocyclic Acids.** Unstable sulphur derivatives of the general formula,  $\text{HOOC.CH}_2\text{S(R)}_2\text{OH.}$

**Sulphion.** (Sulphidion.) The ion  $\text{S}''$  derived from hydrogen sulphide or inorganic sulphides in solution.

**Sulphonide.** A sulphate. (Obs.)

**Sulphite.** A salt of sulphurous acid,  $\text{H}_2\text{SO}_3$ .

**Sulpho-Acids.** Sulphonic acids.

**Sulphocyan Group.** The group  $\text{N}\equiv\text{C-S-}$  which occurs in thiocyanates.

**Sulpho Group.** The univalent group  $-\text{SO}_2-\text{OH}$  characteristic of the sulphonic acids.

**Sulphones.** Organic sulphur derivatives of the type,  $\text{R-SO}_2\text{-R.}$

**Sulphonic Acids.** An important class of organic compounds which contain the sulpho group united to alkyl or aryl residues which may be variously substituted, e.g. methyl sulphonic acid,  $\text{C}_6\text{H}_5\text{SO}_2\text{OH}$ , benzene sulphonic acid,  $\text{C}_6\text{H}_5\text{SO}_2\text{OH}$ , sulphanilic acid, 1-4,  $\text{NH}_2\text{C}_6\text{H}_4\text{SO}_2\text{OH.}$

**Sulphonation.** Conversion into a sulphonic acid. The substitution of the sulpho group for hydrogen in an organic compound.

**Sulphonium Compounds.** See sulphine compounds.

**Sulphoxides.** Sulphur analogues of the ketones, e.g. methyl sulphoxide,  $(\text{CH}_3)_2\text{S.O.}$

**Sulphur.** Non-metallic element.  
S. At. Wt. 32.06. Mol. Wt. 256.48.  
S. G. M. P. B. P.  
amorphous, soft, 1.9556 above  $120^\circ$  444.6°  
amorphous, yellow, 2.046 “  
rhombic, 2.05 114.5° “  
monoclinic, 1.985 119.25° “  
plastic, 1.92 “

Occurs native and as sulphides, and sulphates. Valence 2, 4, and 6. Oxides,  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{S}_2\text{O}_3$ ,  $\text{S}_2\text{O}_7$ . Acids, hydrosulphuric,  $\text{H}_2\text{S}$ ; hydrogen persulphide,  $\text{H}_2\text{S}_2$ (?), hyposulphurous,  $\text{H}_2\text{-S}_2\text{O}_4$ ; persulphuric,  $\text{H}_2\text{S}_2\text{O}_8$ ; Caro's acid,  $\text{H}_2\text{S}_2\text{O}_6$ ; thiosulphuric,  $\text{H}_2\text{S}_2\text{O}_3$ ; dithionic,  $\text{H}_2\text{S}_2\text{O}_6$ ; trithionic,  $\text{H}_2\text{S}_3\text{O}_6$ ; tetrathionic,  $\text{H}_2\text{S}_4\text{O}_6$ ; pentathionic,  $\text{H}_2\text{-S}_5\text{O}_6$ ; hexathionic,  $\text{H}_2\text{S}_6\text{O}_6$ ; sulphurous,  $\text{H}_2\text{SO}_3$ ; and sulphuric,  $\text{H}_2\text{SO}_4$ .

**Sulphurett.** A sulphide. (Obs.)

**Sulphuretted.** Combined with sulphidic sulphur. (Obs.)

**Sulphuric.** 1. A compound of sulphur in which the element exhibits its highest valence, 6, as in sulphuric acid.

**Sulphurize.** To combine with sulphur.

**Sulphurous.** 1. Containing sulphur in a lower state of valence than in the sulphuric compounds. 2. Sulphurous acid. 3. Any compound or mixture which contains sulphur.

**Sulphuryl.** The divalent radical  $:\text{SO}_2$  found in many compounds, e.g. sulphuryl chloride,  $\text{SO}_2\text{Cl}_2$ .

**Sultams.** Derivatives of 1-8 naphthylamine sulphonic acid (I) which part with water forming sultams, e.g.



formula has a plane of symmetry, as the meso forms of optical isomers. Symmetrical tri derivatives of benzene are those substituted in the 1-3-5 positions. Cf. benzene. The correlative term is asymmetrical.

**Symmetry, Axis of.** An imaginary line drawn through a crystal or a configuration of a stereo-isomer which has no plane of symmetry, about which the configuration is symmetrical.

**Symmetry, Indirect.** See pseudo-symmetry.

**Symmetry, Plane of.** An imaginary plane which may pass through a crystal or the configuration of a stereo-isomer dividing the structure into two parts one of which is the mirror image of the other. Cf. meso forms.

**Sympathetic Reactions.** Induced reactions; see under reactions.

**Syn-Type Isomerism.** See isomerism, syn-anti.

**Synaldoximes.** See isomerism, geometrical.

**Syneresis.** The contraction of a gel with accompanying pressing out of the interstitial solution or serum. Observed in the clotting of blood, with silicic acid gels, etc.

**Synthesis.** The combination of elements or compounds to produce compounds of greater molecular weight, e.g.  $H_2 + Cl_2 = 2HCl$  is a synthesis or synthetic reaction. In organic chemistry synthesis is applied to the process of preparing a compound from its elements or from other compounds which can be synthesized from their elements, nothing being used that is a product of a living organism.

**Synthesis, Hantzsch's.** A method for the synthesis of pyridine derivatives. Hantzsch prepared dihydrocollidine dicarboxylic ester by the condensation of two molecules of acetoacetic ester and one of aldehyde ammonia, three molecules of water being eliminated.

**Synthesize.** To prepare a compound from its constituent elements or from other compounds which can be prepared from their constituent elements.

**Synthetic.** Artificial. Produced outside the organism.

**Syntonins.** Acid albumins.

**Syrup.** A viscous, heavy, watery solution of a carbohydrate, especially of cane sugar. Official syrup of the United States Pharmacopoeia is made by dissolving 850 grams of cane sugar in enough water to make one liter. It contains about 65% of sugar.

## T.

**Tanning.** The process of converting hides into leather. The agents used are tannins, metallic hydroxides (from alum and chromic salts), and oils (cod liver and whale oils). The mechanism of the process is now supposed to be an adsorption of the tanning agent on the surface of the fibre.

**Tannins.** A group of naturally occurring carbon compounds characterized by the following properties; they are amorphous, astringent, precipitate gelatine from solution, convert hide into leather, precipitate many alkaloids and glucosides from solution, form insoluble compounds with lead and copper, react with ferric salts to produce deep blue or green colors, in alkaline solution they absorb oxygen, and strike a deep red color with ammonia and aqueous potassium ferricyanide. The chemistry of the tannins is very incomplete but some of them appear to be glucosides.

**Tantalum.** Metallic element. Ta. At. Wt. 181. S. G. 14.49. S. heat 0.03017. M. P. 2300°. Occurs in ytrotantalite and fergusonite. Valence 2 and 5. Oxides  $TaO_2$ ,  $Ta_2O_5$ . Tantalic acid  $HTaO_4$ , pertantallic acid  $HTaO_6$ .

**Tautomerism.** (Tautomeric change.) See isomerism, dynamic.

**Tautomerism, Functional.** A type of tautomerism in which the isomers possess different chemical functions, as keto-enol, amide-imido, etc., tautomerism.

**Tautomerism, Electrolytic.** The phenomenon of changing electric distribution according to the electric character

of the environment. It is shown by amphoteric substances which form hydrogen ions in the presence of bases and hydroxyl ions in the presence of acids.

**Tautomerism, Virtual.** A type of tautomerism in which the isomers possess similar chemical properties or functions, e.g. the amidine type,

$RNH-C : NR' \rightleftharpoons RN : C-NHR'$ ,  
in which there is an oscillation of a double bond.

**Tautorotation.** Mutarotation, q.v.

**Tawing.** A tanning process in which mineral agents, as alum or chromium salts, are employed to convert the hide into leather.

**Tellurium.** Non-metallic element. Te. At. Wt. 127.5. Mol. Wt. 255. Exists in two allotropic forms, amorphous: S. G. 6.015, S. heat 0.0525, M. P. 446°, B. P. 1390°, and crystalline: S. G. 6.27, S. heat 0.0475, M. P. 452°, B. P. 1390°. Occurs in sylvanite, tetradymite, silver telluride, etc. Valence 2, 4, (6). Oxides,  $TeO$ ,  $TeO_2$ ,  $TeO_3$ . Acids,  $H_2Te$ ,  $H_2TeO_3$ ,  $H_2TeO_4$ .

**Telluric.** Compounds of tellurium in which it is sexavalent.

**Tellurous.** Compounds of tellurium in which it is quadrivalent.

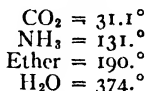
**Temperature.** (t.) The intensity factor of heat energy. The temperature of a body is its condition of thermal intensity referred to an arbitrary standard.

**Temperature, Absolute.** (T.) 1. The temperature measured on the



thermodynamic scale. 2. The temperature measured from the absolute zero ( $-273.1^{\circ}$  C.). Degrees centigrade  $+273.1$  = degrees absolute.

**Temperature, Critical.** A temperature (in degrees centigrade or absolute), definite for each specific gas, above which the gas cannot be liquefied by any pressure, however great. The following are some common critical temperatures (in degrees C.).



**Temperature Gradient.** The space rate of change of temperature, or  $(t_1 - t_2)/l$ , where  $l$  = length. It is inversely proportional to the thermal conductivity of a substance.

**Temperature, Neutral.** The temperature at which the E.M.F. produced by heating one junction of a thermocouple reaches a maximum. Above this temperature the E.M.F. steadily decreases until it reaches a zero value. The latter point is called the temperature of inversion. For an iron-copper couple the neutral temperature is  $275^{\circ}$  and the temperature of inversion  $550^{\circ}$ .

**Temperature, Normal.** The temperature referred to the hydrogen thermometer, i.e. practically in degrees centigrade.

**Temperature of Explosion.** (Ignition or kindling temperature. Flash point.) The minimum temperature which will enable explosion to take place.

**Temperature of Inversion.** See temperature, neutral. The transition temperature is sometimes known as the inversion temperature.

**Temperature of Reaction.** The minimum temperature at which a given reaction will take place. N.B.

It is still unsettled whether such a point exists; some argue that a reaction proceeds however low the temperature.

**Temperature, Standard.** Zero degrees centigrade or  $273.1^{\circ}$  on the absolute scale.

**Temperature, Thermodynamic Scale.** A scale of absolute temperature independent of the specific properties of any substance, derived through the equation  $Q_1/Q_2 = T_1/T_2$ , on the assumption of an ideal gas. Temperatures obtained from the hydrogen thermometer are very close to these theoretical temperatures.

**Temperature, Transition.** (Transition point, inversion temperature.) That temperature at which one phase of a complete heterogeneous equilibrium disappears and another phase takes its place.

Rhombic to monoclinic sulphur,  $95.6^{\circ}$ .  
 $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  to  $\text{Na}_2\text{SO}_4$  + solution,  $32.383^{\circ}$ .  
 $\text{NaBr} \cdot 2\text{H}_2\text{O}$  to  $\text{NaBr}$  + solution,  $50.674^{\circ}$ .  
 $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$  to  $\text{MnCl}_2 \cdot 2\text{H}_2\text{O}$  + solution,  $58.089^{\circ}$ .  
 $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  to  $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$  + solution,  $61.341^{\circ}$ .

**Temperature, Inversion.** See temperature, transition, and of inversion.

**Tendency.** The effect of a difference in intensity in a system when equalization is restrained by a counter force. Equalization of intensities tends to take place; it will take place when the opposing force is withdrawn.

**Terbium.** Metallic element. Tb. At. Wt. 159.2. Valence 3. Occurs in gadolinite. Oxides  $\text{Tb}_2\text{O}_3$ ,  $\text{Tb}_4\text{O}_7$ .

**Termolecular Reactions.** (Trimolecular reactions.) Reactions of the third order. See reactions, termolecular.

**Ternary Compounds.** See theory, dualistic.

**Terpenes.** A class of unsaturated hydrocarbons of the formula  $C_{10}H_{16}$ . They and their derivatives occur in essential oils. Sesquiterpenes, camphors, thymol, and menthol are closely related substances. Terpenes are classified as mono-cyclic and bicyclic according to whether they may be regarded as derivatives of p- or m-cymene or of a nucleus which contains a bridged ring. The first group, menthadienes, are represented by dipentene, terpinolene, and phellandrene; the second by pinene, camphene, and fenchene. Camphene is the only solid terpene. See sesquiterpenes and hemiterpenes.

**Tertiary.** A term applied to certain organic compounds, such as alcohols and amines, to distinguish them from closely related compounds of the same class which are termed primary, secondary, etc. In tertiary compounds the characteristic group is bound to three non-elementary radicals, e.g.  $(R)_3C.OH$ , tertiary alcohols;  $(R)_3N$ , tertiary amines.

**Tertiary Alcohols.** See alcohols.

**Tervalent.** (Trivalent.) Having a valence of three, as chromium, nitrogen, etc.

**Test.** A trial or criterion of a decisive kind by which the internal properties of a substance are tried and proved.

**Test Solution.** A solution used as a reagent.

**Tetartohedral Crystals.** Crystals which show right and left hemihedral forms like optical isomers.

**Tetra-.** A prefix which signifies four, as tetravalent, tetratomic, tetramethyl.

**Tetrabasic.** An acid which contains four replaceable hydrogen atoms, e.g.  $H_4P_2O_7$  (pyrophosphoric acid).

**Tetrad.** A quadrivalent element, e.g. manganese, sulphur, carbon.

**Tetramido Compounds.** See tetramines.

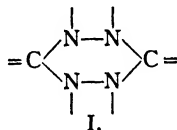
**Tetramino Compounds.** Tetramines, q.v.

**Tetramines.** Compounds which contain four amino groups  $(NH_2)$ , also called tetramido compounds, as tetramidobenzene,  $C_6H_2(NH_2)_4$ .

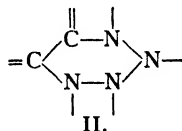
**Tetratomic.** Containing four hydroxyl groups.

**Tetravalent.** (Tetravalence.) Having a valence of four. A tetrad. Quadrivalent.

**Tetrazines.** Compounds which contain either of the nuclei,



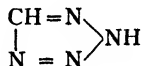
or



Derivatives of nucleus II. are also termed osotetrazones.

**Tetrazo Compounds.** Bisazo compounds.

**Tetrazoles.** Derivatives of tetrazole,



**Tetrazones.** Derivatives of the

hypothetical compound  $\text{NH}_2\text{N} : \text{N} : \text{NH}_2$ , as dimethyldiphenyl tetrazone,  $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)\text{N}_2\text{N}(\text{CH}_3)\text{C}_6\text{H}_5$ .

**Tetroxide.** An oxide which contains four oxygen atoms, as nitrogen tetroxide,  $\text{N}_2\text{O}_4$ .

**Thallic.** Salts of thallium in which that metal is trivalent.

**Thallium.** Metallic element. Tl. At. Wt. 204. S. G. 11.85. S. heat 0.0326. M. P. 301.7°. B. P. 1280°. Valence 1 and 3. Occurs in certain iron and copper pyrites, crookesite, lorandite. Oxides,  $\text{Tl}_2\text{O}$ ,  $\text{Tl}_2\text{O}_3$ .

**Thallous.** Salts of thallium in which that element is univalent.

**Theorem.** An established principle, a rule.

**Theory.** 1. The collected principles which underlie and govern the phenomena of a science. 2. A scientific doctrine which is confirmed as far as our present knowledge can confirm anything of an hypothetical nature. Cf. hypothesis.

**Theory, Dualistic.** Berzelius' hypothesis that each element possesses a definite quantity of positive or negative electricity which causes the exhibition of affinity and leads to chemical combination. Compounds of the "first order" were formed when two elements combined, as potassium and oxygen to form potassium oxide, but in these compounds one electrical charge was not wholly neutralized so that they might react with other first order compounds of opposite charge to form binary compounds, as  $\text{K}_2\text{O} \cdot \text{SO}_3$ . In these compounds of the "second order" some electrical energy might be left unsatisfied and they could react to form "ternary" compounds, e.g. the alums and other double salts. The theory is incompatible with such facts as the union of electromagnetic elements to form neutral compounds and

has been abandoned. This hypothesis is also known as the electrochemical theory of Berzelius.

**Theory of Types.** Dumas postulated that, among organic compounds, there exist certain types which persist through derivatives formed by substitution of halogens, etc., for the hydrogen of the type compounds. Chemical types were found in those cases where derivative and parent possess the same general properties, as chloroacetic and acetic acids; mechanical types in cases where substitution produces a dissimilar compound, as acetic acid and alcohol.

**Theory of Valency.** The theory that atoms combine with other atoms in proportion to a property known as valence, the standard of which is the valence of hydrogen taken as one, or, better, of oxygen taken as two.

**Therm.** A unit of heat equivalent to 1,000 large calories used in expressing the calorific value of feeds. The value for the therm is also given as equal to the small calorie. There appears to be no real necessity for this unit.

**Thermal.** Of or pertaining to heat, as thermal capacity, thermal conductivity.

**Thermal Capacity.** A property of a substance numerically equal to the quantity of heat necessary to change the temperature of unit mass of substance one degree centigrade. Cf. specific heat.

**Thermal Conductivity.** The ability to conduct heat through an unequally heated system from a region of high to one of lower temperature. The coefficient of thermal conductivity is the time rate of heat conduction per unit area per unit temperature gradient.

**Thermal Deformation.** See pyroelectric excitement.

**Thermal Energy.** Heat energy.

**Thermochemistry.** That branch of chemistry which deals with the relations between thermal and chemical energies.

**Thermocouple.** (Thermoelement.) If the ends of two bars of different metals are joined so as to form a closed circuit and one junction be maintained at a higher temperature than the other an electric current flows through the circuit. Such a system is termed a thermocouple or thermoclement. A number of couples connected in series so that a larger current may be obtained is called a thermopile.

**Thermodynamics.** That branch of physics which, assuming the kinetic nature of heat, studies the relationships between heat and other forms of energy and the laws which govern their interconversion.

**Thermodynamics, First Law of.** See law of the conservation of energy.

**Thermodynamics, Second Law of.** See law of the degradation of energy.

**Thermoelectromotive Force.** Electromotive force produced by heat. Specifically, the total E.M.F. which arises from a temperature difference at the junction of two dissimilar metals, as in a thermocouple.

**Thermoelement.** See thermocouple.

**Thermolabile.** Destroyed or greatly altered by moderate heating. Coagulable proteins, microorganisms, bacterial toxins, and certain isomers are examples.

**Thermoluminescence.** See luminescence.

**Thermometer.** An instrument used to measure the intensity of the heat in a body, i.e. its temperature, usually

constructed so that the expansion of matter caused by heat furnishes the measure of the temperature. Instruments for measuring high temperatures are termed pyrometers. In the standard thermometer, or hydrogen thermometer, the change in volume produced by rise of temperature is not measured but the change in pressure necessary to keep a volume of hydrogen gas at constant volume is the measure of the temperature change. The zero point of the hydrogen thermometer is equal to  $0^{\circ}$  C. and is so adjusted that the gas is under 100 cm. pressure. The difference between readings on the hydrogen thermometer and the best centigrade instruments is very slight.

**Thermometric Scales.** The absolute scale,  $0^{\circ}$  = absolute zero ( $-273.1^{\circ}$  C.). One degree = 1 degree C. Centigrade scale,  $0^{\circ}$  = freezing point of water (temp. of melting ice)  $100^{\circ}$  = boiling point of water, both under standard conditions. Fahrenheit scale,  $32^{\circ}$  = temperature of melting ice,  $212^{\circ}$  = boiling point of water. Réaumur scale,  $0^{\circ}$  = temp. of melting ice,  $80^{\circ}$  = boiling point of water. The obsolete De Lisle scale,  $0^{\circ}$  = boiling point of water,  $100^{\circ}$  = temp. of melting ice. Degrees C. =  $5/9$  (F. -  $32$ ). Degrees F. =  $9C/5 + 32$ . At  $-40^{\circ}$  the centigrade and Fahrenheit readings are identical.

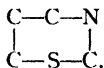
**Thermopile.** See thermocouple.

**Thermostable.** Neither destroyed or altered by moderate heating.

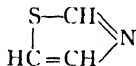
**The mostat.** An apparatus arranged so that it may be adjusted to furnish and keep constant any practicable temperature. A system enclosed in a thermostat is thus kept at a definite constant temperature.

**Thetines.** Cyclic sulphinates. See sulphinates.

**Thiazines.** Compounds derived from a six-membered ring nucleus which contains one sulphur and one nitrogen member, viz.,



**Thiazole.** A heterocyclic sulphur compound,



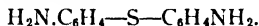
**Thio-.** A prefix which indicates content of sulphur, e.g. thiosulphate, thio-cyanate, thio-alcohol.

**Thio-Acids.** (Thiolic acids.) Carboxylic acids in which the hydroxyl oxygen has been replaced by sulphur, as  $\text{R}-\text{CO}.\text{SH}$ . If the carbonyl oxygen has been replaced (as,  $\text{R}-\text{CS}(\text{OH})$ ) the compound is a thionic acid. When both have been replaced (as,  $\text{R}-\text{CS}.\text{SH}$ ) a dithionic or thionthiolic acid results.

**Thio-Alcohols.** Mercaptans, q.v.

**Thiënyl Group.** The univalent group  $\text{C}_4\text{H}_5\text{S}$  derived from thiophene.

**Thioanilines.** Sulphur derivatives of the cyclic amines, as p-diamidodiphenylsulphide,



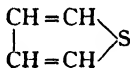
**Thiocarbonates.** Salts of thio-carbonic acid,  $\text{H}_2\text{CS}_3$ .

**Thionic Acids.** See thio-acids.

**Thionthiolic Acids.** See thio-acids.

**Thionyl.** The divalent group : S : O, as in thionyl chloride,  $\text{SOCl}_2$ .

**Thiophene.** An heterocyclic sulphur compound the parent of numerous derivatives.



All thiophene derivatives give an intense blue color with isatin and con. sulphuric acid. Cf. thiënyl.

**Thiophenols.** Phenols in which the hydroxyl oxygen has been replaced by sulphur, as phenylmercaptan (thiophenol, phenthiol),  $\text{C}_6\text{H}_5\text{SH}$ .

**Thioxenes.** Dimethyl thiophenes.

**Thiozonides.** A class of sulphur compounds analogous to the ozonides and formed from thiozone.

**Third Order Reactions.** See reactions, termolecular.

**Thorium.** Metallic element. Th. At. Wt. 232.15. Exists in two allotropic forms: Amorphous, S. G. 11.00. M. P.  $1515^\circ$ . Crystalline, S. G. 11.23. Valence 4. Occurs in thorite. Oxides  $\text{ThO}_2$  ( $\text{ThO}_2$ ). Radioactive, period of half-decay  $2.4 \times 10^9$  years. Emits no rays.

**Thulium.** Metallic element. Tm. At. Wt. 168.5. Occurs in gadolinite.

**Time, Unit of.** The unit of time in all physico-chemical measurements is the second.

**Tin.** Metallic element. Sn (Stannum). At. Wt. 119. Exists in three allotropic forms, gray, rhombic, and tetragonal tin. Occurs native, and in cassiterite. Valence 2 and 4. Forms two series of salts, the stannous salts in which it is divalent and the stannic salts in which it is quadrivalent. Oxides,  $\text{SnO}$ ,  $\text{SnO}_2$ . Acids, stannic,  $\text{H}_2\text{SnO}_3$ , metastannic,  $\text{H}_2\text{SnH}_3\text{O}_{10}$ , perstannic,  $\text{HSnO}_4$ .

**Tincture.** (Tr.) An alcoholic liquid containing the soluble matters of some drug, as Tr. Nux Vomica, or a dissolved compound as Tr. Ferric Chloride or Tr. Iodine. Tinctures are more dilute than fluid extracts and differ from spirits in not being wholly volatile.

**Titanium.** Metallic element. Ti. At. Wt. 48.1. S. G. 3.543. S. heat 0.1125. M. P. 3000°. Occurs in ilmenite, rutile, and brookite. Oxides,  $TiO_2$ ,  $Ti_2O_3$ ,  $TiO$ . Valence 2, 3, and 4. Acids, orthotitanic,  $H_4TiO_4$ , metatitanic  $H_2TiO_3$ .

**Titano-.** Pertaining to a compound of titanium.

**Titrate.** To determine the quantity of some component in an "unknown" mixture by adding to it a known reagent which reacts with the unknown in such a way that, from the quantity of known reagent needed exactly to react with the unknown, its weight may be calculated. See Analysis, Quantitative.

**Titration.** The process of determining the quantity of a compound by measuring the quantity of some reagent which exactly reacts with it.

**Toluy! Group.** The group  $CH_3-C_6H_4.C:O-$  derived from toluene. It may be regarded as a methyl benzoyl group.

**Tolyl Group.** The univalent group  $CH_3.C_6H_4-$  which bears the same relation to toluene than the phenyl group bears to benzene.

**Tournesol.** Litmus.

**Toxalbumins.** (Venins.) Toxic substances of protein nature similar to the bacterial toxins but not produced by microorganisms, as the toxins of rattlesnake and cobra venom, and the plant toxalbumins ricin, abrin, and robin.

**Toxicology.** The science which studies the nature, actions, and relations of poisonous substances and the methods for treating poisoning.

**Toxin.** 1. Any poisonous substance. 2. Plant poisons of unknown composition. 3. Bacterial toxins, poisonous

substances produced by microorganisms. 4. The toxalbumins or venins.

**Toxophore Groups.** (Toxophore molecules.) The portion of the bacterial toxins which have the specific poisonous properties shown by the toxins.

**Transference Number.** See Hittorf number.

**Trans Form.** The fumaroid or axially symmetric form of geometrical isomers. See isomerism, geometrical.

**Transition, Heat of.** The heat change which takes place when one polymorphic form is converted into another, as rhombic to monoclinic sulphur.

**Transition Point.** } See tem-  
**Transition Temperature.** } perature,  
transition.

**Transitory Pressures.** See pressures, fugitive.

**Transmutation.** 1. A change in the configuration of a labile stereoisomer to the more stable form, as the transmutation of maleic into fumaric acid. 2. The conversion of one element into another, particularly the preparation of gold and other noble metals from various base metals.

**Transport Number.** (Shares of transport.) The Hittorf number.

**Tree, Lead.** The precipitate of metallic lead which occurs when a bar of zinc is suspended in an aqueous solution of a lead salt. The lead adheres to the zinc and assumes an arboreal form.

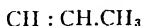
**Tri-.** A prefix which indicates three. Cf. ter-.

**Triacid.** A base capable of neutralizing three equivalents of monobasic acid.

**Triads.** 1. A class of tautomeric compounds in which the wandering hydrogen atom is supposed to travel from one polyvalent atom past a second to a third in a chain of three such atoms. E.g. in the conversion of eugenol into isoeugenol,



HO



HO



Cf. dyads. 2. Trivalent elements, as nitrogen chromium, or aluminium. 3. A molecule which contains three atoms. (Obs.)

**Triads of Döbereiner.** Groups of three elements which show similar chemical properties and nearly constant differences in physical properties, atomic weights, etc., as Ca, Ba, Sr; Li, Na, K; S, Se, Te; etc.

**Triamido Compounds.** See triamines.

**Triamines.** Compounds which contain three amino ( $-\text{NH}_2$ ) groups, as triamidobenzene,  $\text{C}_6\text{H}_3(\text{NH}_2)_3$ .

**Triatomic.** 1. Containing three atoms. 2. Containing three hydroxyl groups, as glycerol and pyrogallol.

**Triboluminescence.** Luminescence due to friction. It occurs usually only with crystalline substances. The phenomenon is shown by crystals of uranium nitrate when they are shaken in the dark.

**Trichroism.** The property of exhibiting three different colors when viewed in as many different directions.

**Trientoxide.** An oxide in which the proportion of (divalent) metal to oxygen is as three to one, e.g.  $\text{Cu}_3\text{O}$ .

**Trimolecular Reactions.** See reactions, termolecular.

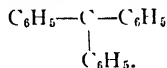
**Trimorphic.** Crystallizing in three forms, as titanium dioxide.

**Trimorphism.** The property of crystallizing in three forms.

**Trioses.** Monosaccharoses which contain three carbon atoms, as glyceric aldehyde,  $\text{CH}_2\text{OH}.\text{CHOH}.\text{CHO}$ .

**Trioxide.** An oxide which contains three atoms of oxygen to one of other element, as chromium trioxide,  $\text{CrO}_3$ , sulphur trioxide,  $\text{SO}_3$ . Sesquioxides are sometimes termed trioxides, as arsenic trioxide,  $\text{As}_2\text{O}_3$ .

**Triphenylmethyl.** A compound in which carbon is apparently trivalent,



**Triple Point.** A definite condition of temperature and pressure where three phases can co-exist in equilibrium. For the system water, water vapor, ice the triple point co-ordinates are, pressure 4.57 mm., temperature,  $0.0076^\circ$ . If either temperature or pressure be varied one phase (water or ice) disappears.

**Trisazo Compounds.** Compounds which contain three azo ( $-\text{N} : \text{N}-$ ) groups.

**Tris-Nitrate.** A trinitrate, as bis-muthous nitrate  $\text{Bi}(\text{NO}_3)_3$ . (Obs.)

**Trioxide.** A trioxide. (Obs.)

**Trivalence.** The state of being trivalent.

**Trivalent.** (Tervalent.) Having a valence of three; a triad. Aluminium, chromium, nitrogen.

**Tumid.** (bot.) Swollen.

**Tungsten.** Metallic element. W. At. Wt. 184.0. S. G. 18.77. S. heat 0.0336. M. P. 2800°. Valence, 2, 4, 5, 6. Occurs in scheelite and wolfram. Oxides  $WO_2$ ,  $WO_3$ . Acids, tungstic,  $H_2WO_4$ , metatungstic  $H_2W_4O_{13}$ .

**Turmeric.** An indicator which is yellow in acid and brown in alkaline solutions.

**Twin Nuclei.** See nuclei, twin.

**Two Fluid Theory of Electricity.**

The theory that two kinds of electricity, positive and negative, exist in nature.

**Tyndall Effect.** A phenomenon first noticed by Faraday (1857). When a powerful beam of light is sent through a colloidal solution of high dispersity the sol appears fluorescent and the light is polarized, the amount of polarization depending upon the size of the particles of the colloid. The polarization is complete if the particles are less than  $100\mu$  in diameter.

**Types, Chemical and Mechanical.**  
See theory of types.



## U.

**Ultrafiltrate.** The filtrate obtained in ultrafiltration.

**Ultrafiltration.** The separation, by a special method of filtration, of highly dispersed substances in colloidal solutions from the dispersion medium. Ultrafilters differ from ordinary filters only in the fineness of the pores through which the liquid must pass. By using a series of filters of graduated fineness it is possible to prepare a series of sols in which the sizes of the disperse phase particles progressively decrease.

**Ultramicroscopy.** A method for extending the range of vision of the ordinary microscope in which a powerful beam of light is focused into a liquid under examination in such a way that the direction of the light is at right angles to the line of vision in the instrument. The ultramicroscopic particles, i.e. those smaller than 0.25 micron in diameter, are then surrounded by visible diffraction rings and may thus be perceived. Particles as small as 1.7 millimicrons in diameter have been measured in this way. The arrangement of the apparatus for ultramicroscopy is called the ultramicroscope.

**Ultraviolet.** A region of the spectrum which includes those light waves of lengths shorter than those to which the retina of the human eye is sensitive. That part of the spectrum made up of light of wave-length 0.1 to 0.4 microns.

**Unary Substances.** Substances whose molecules are all physically as well as chemically identical. Substances whose molecules all give an

identical ultimate analysis but which show two sorts of physical properties are termed pseudo-binary. Mercury is a unary substance; tin is probably pseudo-binary.

**Undercooling.** (Supercooling.) The phenomenon which occurs when a substance is cooled without change of state below the temperature at which its state of aggregation normally changes. The system is then in a metastable condition and the least influence often will cause the change in state to take place with evolution of heat and a temperature rise in the system to the normal temperature of the change.

**Unimolecular Reactions.** (Monomolecular reactions.) Reactions of the first order; see reactions, unimolecular.

**Unit, British Thermal.** The amount of heat required to raise one pound of water through one degree Fahrenheit.

1 large caloric = 3.96832 B.T.U.

**Units, Derived.** Non-fundamental units which, however, may be expressed in terms of fundamental units. E.g. area, volume, density, etc.

**Units, Fundamental.** Units for physical quantities which are so chosen that they bear the same relations to each other as their corresponding physical magnitudes bear to each other. In the c.g.s. system these units are the centimeter, gram, and second.

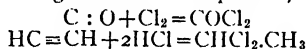
**Univalence.** The state of being univalent.

**Univalent.** (Monovalent.) Having a valence of one, as hydrogen, chlorine, sodium, etc.

**Univariant System.** According to the phase rule, a system which has but one degree of freedom, e.g. the system liquid water  $\rightleftharpoons$  water vapor.

**Unorganized Ferments.** Enzymes unconnected with living cells and capable of acting in sterile media.

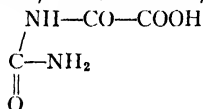
**Unsaturated Compounds.** Substances which contain one or more elements of which the total valence is either not satisfied or is satisfied by union with another atom of the same element. C : O is an example of the first class;  $\text{H}_2\text{C} : \text{CH}_2$  an example of the second. Unsaturated compounds add hydrogen, halogens, ozone, halogen acids, and other compounds directly producing saturated compounds, viz.,



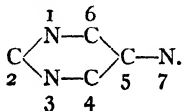
**Unsymmetrical.** (Asymmetrical.) Having no plane of symmetry. The asymmetrical atoms, q.v. The asymmetrical derivatives of benzene, etc.

**Unsymmetrical Carbon Atom.** The asymmetrical carbon atom. See isomerism, optical.

**Ur-Acids.** Hydrolytic products of cyclic ureids, as oxaluric acid,



**Uramil.** Amidomalonyl urea. The positions of substituents in its derivatives are defined by numbering its ring atoms thus



**Uranic.** Salts of uranium in which that metal is sexavalent as the chloride,  $\text{UO}_2\text{Cl}_2$ , often called uranyl chloride, and uranic fluoride,  $\text{UF}_6$ .

**Uranium.** Metallic element. U. At. Wt. 238.2. S. G. 18.685. S. heat 0.0280. M. P.  $1500^\circ$ . Valence 3, 4, 5, and 6. Oxides  $\text{U}_2\text{O}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$ ,  $\text{UO}_3$ ,  $\text{UO}_4$ . Acid,  $\text{H}_2\text{UO}_4$  analogous to chromic acid. Ore, pitchblende. Radioactive, emits  $\alpha$  and  $\beta$  rays, decomposing into uranium X and helium.

**Uranium X.** Degradation product of uranium. At. Wt. 230.5. It emits  $\beta$  and  $\gamma$  rays and decomposes into ionium. Average life 35.5 days.

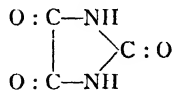
**Uranoso.** Pertaining to uranium compounds where the element is quadrivalent, as uranoso-uranic oxide.

**Uranous.** Salts of uranium in which that metal is quadrivalent, as  $\text{UCl}_4$ .

**Uranyl.** The divalent radical  $\text{UO}_2$ , found in some uranic salts, as  $\text{UO}_2\text{Cl}_2$ , and in uranic acid,  $\text{UO}_2(\text{OH})_2$ .

**Ureameter.** A urcometer, q.v.

**Ureids.** Derivatives of urea with acid radicals, as acetylurea,  $\text{H}_2\text{N}-\text{C} : \text{O} \cdot \text{NH} \cdot \text{CO} \cdot \text{CH}_3$ , and parabanic acid,

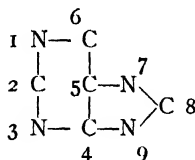


**Ureometer.** An apparatus for determining the amount of urea in a sample of urine by decomposing the urea with sodium hypobromite in sodium hydroxide solution and measuring the evolved nitrogen.

**-uret.** An obsolete suffix equivalent to the modern "ide" where it applies to a salt.

**Urethanes.** Esters of carbamic acid of the general form  $H_2N.C : O.O.R.$

**Uric Acid Derivatives.** The positions of substituents in uric acid derivatives are defined by numbering the skeleton atoms as follows:



Cf. purine derivatives.

**Uricolysis.** The conversion of uric acid to urica in the organism.

**Uricolytic Enzymes.** Enzymes which catalyze the destruction of uric acid.

**Uricolytic Index.** A measure of the degree of uricolysis in an organism. Among rodents, herbivora, and carnivora it is very high (80 to 98) while in man it is low (2).

**Urine Analysis.** The clinical analysis of urine for indications of pathological conditions in the body. Samples of urine are tested particularly for specific gravity, color, presence of proteins, reducing sugars, acetone,  $\beta$  oxybutyric acid, and quantitative determinations of ammonia, urea, phosphates, and sugars (if present) are made. Other substances are determined only in special cases. The microscopic examination of the sediment is an integral part of the analysis.

**Urinometer.** A hydrometer used to take the specific gravity of samples of urine. Any hydrometer for liquids heavier than water will serve.

## V.

**Vacuum.** Theoretically a space devoid of matter; practically a space from which as much matter has been abstracted as is possible with our present means.

**Vacuum Pan.** An apparatus for conducting evaporation under reduced pressure used extensively in the sugar and pharmaceutical industries. Vacuum pans are made in a variety of styles.

**Valence.** A property of an element (and a radical) numerically equal to the atomic (or molecular) weight divided by the combining weight. Valence may be defined as the number of atoms of hydrogen, or its equivalent, one atom of an element can combine with. Thus the valence of chlorine is one, as one atom of chlorine combines with one atom of hydrogen; chlorine also exhibits higher valence in some compounds. Many elements possess more than one valence, as iron, nitrogen, sulphur, etc. Elements are characterized as univalent, bivalent, trivalent, multivalent, etc., using the Latin prefixes, or as monovalent, divalent, trivalent, polyvalent, using the Greek prefixes, according to the numerical value of their valence, one, two, three, many, etc. Valence is also termed, quantivalence, equivalence, and combining capacity. Cf. valency.

**Valence, Active.** The valence which an element exhibits in any compound to distinguish it from "maximum" valence, as the active valence of iron in the ferrous salts is two.

**Valence, Auxiliary.** (Secondary or supplementary valence.) The valence which enables molecules to form stable

unions just as if these molecules were radicals able to exist as independent compounds. Werner represents this auxiliary valence by a dotted line, i.e.  $\text{NH}_3 \dots \text{HCl}$ .

**Valence, Chief.** (Primary valence.) A term used by Werner to specify that valence of an element which can be expressed in hydrogen atoms or their equivalents, as the primary valence of nitrogen is three. Cf. auxiliary valence.

**Valence, Contra.** See contravalence.

**Valence, Free.** (Sleeping valency. Latent bonds.) Valence which does not appear to be satisfied, as two of the valencies of carbon in carbon monoxide :  $\text{C} : \text{O}$ .

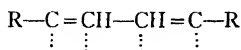
**Valence, Maximum.** The highest valence shown by an element in any of its compounds. With chromium it is six, potassium, one, nitrogen, five, etc.

**Valence, Normal.** 1. The valence which an element exhibits in a great majority of its compounds. 2. See contravalence.

**Valence, Null.** According to the electron conception of valence, a condition in which an element has no valence because it is unable to retain a positive or negative charge, e.g. the system of 59 electrons in Thomson's theory.

**Valence, Partial.** Thiele's assumption that atoms which are doubly linked possess extra valence by which union with other elements is first

effected. It is represented thus, the dotted lines indicating the partial valence,



Cf. conjugated double bonds.

**Valence, Potential.** Residual affinity.

**Valence, Primary.** See valence, chief.

**Valence, Secondary.** See valence, auxiliary.

**Valence, Supplementary.** See valence, auxiliary.

**Valency.** 1. Valence. 2. The numerical value of the valence. 3. The symbols used to represent valence.

**Valency Electrons.** (Valency corpuscles. Mobile electrons.) Mobile electrons which are assumed to form a bond between atoms enabling atoms to hold to one another in combinations.

**Valency Isomerism.** Isomerism due to difference in linkage of primary and auxiliary valencies.

**Valency, Sleeping.** See valence, free.

**Valency Volume.** A quantity numerically equal to the sum of the valences of the atoms contained in a molecule.

**Vanadic.** Compounds of vanadium in which that metal is trivalent, as  $\text{VCl}_3$ .

**Vanadious.** (Vanadous.) Compounds of vanadium in which that metal is divalent, as  $\text{VCl}_2$ .

**Vanadium.** Metallic element. V. At. Wt. 51.0. S. G. 6.025. S. heat 0.1240. M. P. 1680°. Valence 2, 3, and 4. Ore, vanadinite. Oxides,  $\text{V}_2\text{O}$ ,  $\text{V}_2\text{O}_2$ ,  $\text{V}_2\text{O}_3$ ,  $\text{V}_2\text{O}_4$ ,  $\text{V}_2\text{O}_5$ . The higher oxides exhibit acidic properties.

**Vanadous.** Vanadious.

**Vanadyl.** The trivalent radical  $\text{VO}$ , as in vanadyl chloride,  $\text{VOCl}_3$ .

**Vapor.** A gas. Sometimes the term is restricted to those gases which may be easily condensed or which exist as liquids or solids at ordinary temperatures.

**Vapor Bath.** A steam bath.

**Vapor Density.** The density of a gas referred to hydrogen as unity. If hydrogen is taken as 2 the vapor density is approximately the molecular weight, if it is taken as one the vapor density equals half the molecular weight.

**Vaporimeter.** An instrument used to determine the vapor tension of a substance, particularly that of alcoholic liquids, whereby their content of alcohol may be estimated.

**Vaporization, Heat of.** (L.) (Latent heat of vaporization, heat of evaporation.) The amount of heat in calories required to convert one gram of a substance into its vapor without temperature change. The amount of heat required varies with the temperature at which the evaporation is carried on, decreasing as the temperature increases, thus for water,

t.	L.
0.°	596.3 cal.
25.	582.5
75.	553.3
100.	538.0

The heat of vaporization of a solid is termed its heat of sublimation.

**Vaporization, Molecular Heat of.** (λ.) (Molecular heat of evaporation.) The heat of vaporization of one-gram molecule of any substance, numerically equal to the product of the heat of vaporization and the gram-molecular

weight, thus at 100° the molecular heat of vaporization of water is

$$\frac{538 \times 18.016}{(L) \quad (M.Wt.) \quad (\lambda)} = 9692.6 \text{ cal.}$$

**Vapor Pressure.** The pressure exerted by a vapor under equilibrium conditions and in contact with its solid or liquid phase. The vapor pressure of all substances increases with rise in temperature until, at the boiling point, the vapor pressure equals the atmospheric pressure.

**Vapor Tension.** The tendency of a liquid to enter the vapor state, balanced by and numerically equal to, the vapor pressure.

**Varnish.** A solution of a resin or a drying oil in a volatile solvent or in a drying oil. Varnishes are classified as spirit, turpentine, and linseed oil varnishes according to the solvent used.

**Vegetable Chemistry.** Phytochemistry.

**Velocity Coefficient.** See coefficient, velocity.

**Velocity Constant.** See constant, velocity.

**Verticillate.** (bot.) Leaves disposed in a whorl.

**Vibration, Atomic Theory of.** The hypothesis that the atoms in any molecule are in a state of continual and orderly vibration which carries them about certain fixed points.

**Vibrations, Synchronous. Theory of.** Abel's theory that there is a synchronism between the vibrations induced in air or in the ether by detonators and the natural period of vibration of the molecules of certain explosives, to explain the fact that mercury fulminate is superior to nitroglycerin as a detonator for gun-cotton.

**Vibratory Volume.** See co-volume, molecular.

**Victor Meyer's Esterification Law.** See law, esterification.

**Villous.** (bot.) Having long soft hairs.

**Vinasse.** (Molasses residue. Schlempe.) The residue from the fermentation of beet molasses for alcohol. It contains all the potash salts of the molasses and one to two percent of nitrogenous matter. Sometimes used as a cattle food, otherwise worked up for potash, ammonia, and methyl chloride.

**Vinous Fermentation.** See alcoholic fermentation.

**Vinyl Group.** The univalent group  $\text{CH}_2:\text{CH}-$  found in vinyl chloride,  $\text{CH}_2:\text{CHCl}$  and in vinyl alcohol,  $\text{CH}_2:\text{CHOH}$ . It is physiologically highly active.

**Viscosity.** The internal friction or resistance to flow shown by liquids. Viscosity diminishes with rise of temperature and increases slightly with increased pressure.

**Viscosity, Coefficient of.** For any liquid this figure is given by the equation,

$$Q = \frac{\pi p r^4}{8 l n} \cdot t,$$

where  $p$  represents the difference in pressure,  $Q$ , the quantity discharged through a tube of length  $l$ , and radius  $r$ , in time  $t$ .  $n$  is the coefficient of viscosity. At 15°, for water,  $n = 0.0115$ .

**Vitamines.** A class of organic substances of unknown constitution which are found in many foodstuffs and which appear to be necessary for the growth of the organism. They contain basic nitrogen and are generally soluble in alcohol. They are distinct from proteins, fats, and carbohydrates.

**Vital Force.** The ancient teleological idea that the processes which occur in living organisms differ from those carried on with non-living substances outside the organism by virtue of the influence on the living processes of an hypothetical force inherent in the phenomena of life, which so modifies and conducts living processes as to distinguish them from all others. The synthesis of innumerable "vital" products by the methods of organic chemistry has shown the falsity of the idea.

**Vitrify.** To bring into a state which resembles glass, as in ceramics, to vitrify by firing at a temperature high enough to induce semi-fusion.

**Vitriol.** A name applied to sulphuric acid, also known as oil of vitriol. Certain sulphates which crystallize in the rhombic system with seven molecules of water (or form isomorphous crystals with those that do, as  $\text{CuSO}_4$ ) are termed vitriols, e.g. ferrous sulphate (green vitriol), zinc sulphate (white vitriol), copper sulphate (blue vitriol), magnesium sulphate, manganous sulphate, cobalt sulphate and nickel sulphates, all crystallized with water, constitute the vitriols.

**Vitriolate.** To impregnate with sulphuric acid or a sulphate; to convert into a sulphate. (Obs.)

**Volatile.** Having a low boiling or subliming temperature at ordinary pressure, or a high vapor pressure, as ether, camphor, naphthalene, iodine, chloroform, benzol, or methyl chloride.

**Volatile Alkali.** Ammonia, so called because it may be readily driven from its combinations.

**Volatile Oils.** Essential oils.

**Volatilize.** To convert into vapor, to evaporate.

**Volt.** The unit of the intensity factor of electrical energy defined as the electric pressure which, when steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere. The volt has also been termed the unit of intensity factor of chemical energy. It is nearly identical with the potential developed by the Weston standard cell (1.0183 volts) at 20°. One volt equals  $10^8$  c.g.s. units.

**Voltage.** Electromotive force or difference of potential measured in volts.

**Voltage, Decomposition.** (Discharge potential.) The minimum E.M.F. required to cause steady electrolysis in a solution. In normal solutions of sulphuric acid and zinc sulphate it is 1.67 and 2.35 volts respectively.

**Voltaic.** Furnishing an electric current.

**Voltaic Current.** (Voltaic electricity. Voltaism.) Terms formerly used to designate the electricity furnished by the voltaic pile, before the identity of the electricity from different sources was recognized.

**Voltaic Pile.** An apparatus for generating an electric current consisting of a column of disks. The disks are made of two dissimilar metals (as copper and zinc) and of some absorbent material moistened with a solution of an electrolyte; they are arranged thus: metal No. 1, absorbent disk, metal No. 2, metal No. 1, etc. following the same cycle. The end disks are provided with wires through which the current is obtained.

**Voltaism.** See voltaic current.

**Voltameter.** A coulometer. Cf. voltmeter.

**Voltmeter.** An instrument used to measure difference of potential.

**Volume.** The space occupied by any body. It is definite for any specific temperature and pressure. The unit of volume is the centimeter cube ( $\text{cm}^3$ ) though the cubic centimeter and liter are also used as units. The volume of one gram-molecule of a gas at standard temperature and pressure is about 22.4 liters.

**Volume, Atomic.** A constant of an element. 1. The product of the atomic weight and the specific volume of the solid element, or the quotient of the atomic weight by the specific gravity. It is a periodic function of the atomic weights. 2. The volume occupied by one gram-molecule of an element.

**Volume, Critical.** The volume occupied by one gram of a substance at the critical temperature. The critical volume of carbon dioxide is 3.34 cc.

**Volume, Incompressible.** See incompressible volume.

**Volume, Molecular.** (Gram-molecular volume.) The volume occupied by a gram-molecule of any substance.

**Volume, Specific.** See specific volume.

**Volumetric Analysis.** See analysis, volumetric.

**Volumetric Solutions.** See solutions.

**Volume, Valency.** See valency volume.

**Volumes, Gas, Law of.** See law of Gay-Lussac.

**Vulcanization.** 1. A process of curing rubber which depends upon the union of sulphur with caoutchouc. Soft rubber articles contain 1 to 2% of sulphur, ebonite 20%. 30% of sulphur may be combined, the larger the proportion of sulphur the harder and more brittle the product. 2. Vulcanized fibre is the product of the action of zinc chloride on pure cellulose.



## W.

**Walden's Inversion.** See inversion, optical and Walden's.

**Water, Constants of.** Dielectric constant, 77; temperature of maximum density  $4^{\circ}$  C.; ionization constant ( $25^{\circ}$ ),  $1.2 \times 10^{-14}$ ; concentration of hydrogen ions ( $25^{\circ}$ ),  $1 \times 10^{-7}$ ; conductivity ( $18^{\circ}$ ),  $0.04 \times 10^{-6}$ ; conductivity of absolutely pure water at  $25^{\circ}$  (calc.),  $0.054 \times 10^{-6}$ .

**Water Gas.** The product of the action of steam on incandescent carbon (coal) used as a fuel and illuminant. Its theoretical composition varies with the temperature at which the reaction is run. At  $1000^{\circ}$  it is 49.51% CO, 49.93% H, 0.35%  $H_2O$ , 0.21%  $CO_2$ . In practise the product contains much more carbon dioxide, nitrogen, water, etc.

**Water of Constitution.** (Constitutional water.) 1. Water of crystallization. 2. Water whose presence gives definite physical characteristics to a substance. 3. Certain hydrated salts readily part with a portion of their water of crystallization but retain the remainder more tenaciously. This residue, which is sometimes considered to be differently combined, has been distinguished as water of constitution.

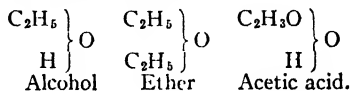
**Water of Crystallization.** (Water of combination, water of hydration.) A crystallized combination of water with certain other substances, particularly metallic salts. Little is known about the actual condition of the water elements within the molecule except that hydrated salts show a definite vapor pressure of water and such combinations may readily dissociate

into anhydrous salts and water. Cf. benzene, alcohol, and chloroform of crystallization.

**Water Type.** One of the four types of organic compounds proposed by Gerhardt (1853), written



Alcohol, ether, and acetic acid were considered compounds of the water type and were formulated,



**Watt.** The unit of power in the c.g.s. system. It is the power that delivers one joule in one second, or the power of an electric current of one ampere with an intensity of one volt.

1 watt = 1 volt-ampere.

1 watt-hour = 3600 joules.

746 watts = 1 horsepower.

**Wave-Length.** In wave motion the distance through which a wave moves during a complete period of one of the moving particles or points, e.g. the distance from the crest of one wave to the crest of the next wave. The unit of wave-length is the ångström, q.v.

**Waxes.** Liquid and solid mixtures of fatty acid esters of higher monohydric aliphatic and phytosterol alcohols, as cetyl palmitate (spermaceti), myricyl palmitate (beeswax), ceryl cerotate (in chinese wax). All plants appear to contain small amounts of

waxes. Waxes are distinguished from fats in that they are esters of monohydric alcohols.

**Weber.** Obsolete term for coulomb.

**Weight.** The force with which a body is attracted towards the earth; the product of the mass of a body and the acceleration due to gravity. The force of 980 dynes is the weight of one gram. The value of the acceleration due to gravity increases slightly from equator to pole so that the weight of a body varies according to its geographical location. The mass of a body, however, is constant.

**Weight, Molecular.** The weight of a molecule of any substance referred to a standard. By international agreement the base for this standard is the weight of the oxygen atom taken as 16. The molecular weight may be calculated by taking the sum of the atomic weights of the constituent elements, each atomic weight being multiplied by the number of atoms of that particular element present in the compound, thus

Mol. Wt. of NaCl,

$$23 + 35.46 = 58.46.$$

Mol. Wt. of  $P_2O_5$ ,

$$(31.04 \times 2) + (16 \times 5) = 142.08.$$

**Weights, Combining.** (Equivalent, reacting, or symbol weights.) The number of parts by weight of any element which can enter into combination with one part, by weight, of hydrogen or eight parts by weight of oxygen, or the atomic weight divided by the valence. Where an element possesses more than one degree of valence the equivalent weight will depend upon the sense in which the element is reacting. In ferrous salts the equivalent weight of iron is 27.92 ( $55.84 \div 2$ ) and in ferric salts it is 18.61 ( $55.84 \div 3$ ). The equivalent weight of a compound is its molecular weight

divided by the valence of its principal element.

**Weights, Equivalent.** See weights, combining.

**Weights, Reacting.** See weights, combining.

**Welter's Rule.** This is a method for approximating the heat of combustion of carbon compounds which contain hydrogen and oxygen. The rule is to subtract the oxygen with as much hydrogen as is necessary to form water with it, when the heats of combustion of the residual carbon and hydrogen give an approximate value of the heat of combustion of the whole compound. This rule gives results about ten percent low.

**Wheatstone Bridge.** A combination of instruments used primarily for measuring resistance. It consists essentially of a system of conductors in which a current is divided into two parts, each fork consisting of two sets of resistance in series after passing through which the current meets in the circuit. If a conductor (bridge) is now placed so that it connects between the two resistances in each fork and these resistances are so adjusted that no current crosses the bridge, the ratio of the resistances in one fork is equal to the ratio of those in the other fork. If three resistances are known or one ratio and one other resistance, the fourth resistance may be calculated.

**Whorl.** (bot.) Leaves, flowers, etc., arranged in a whorl about a stem.

**Wolfram.** Tungstic.

**Wolframium.** Tungsten.

**Wood Spirit.** 1. Methyl alcohol. 2. The first distillate obtained in redistilling the alcoholic fraction obtained in the destructive distillation of

wood. It consists mainly of methyl alcohol with a little acetone.

**Wool Fat.** *Adeps lanac*, U.S.P. An unguentous substance obtained from wool. It consists of the monohydric alcohols cholesterin and isocholesterin and several of their esters with fatty acids. Wool fat is soluble in ether. It is largely used in pharmaceutical preparations.

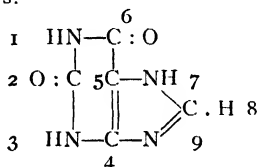
**Work.** That which changes a state

of motion or stress in opposition to resisting forces. Work is said to be done when a force acts through a distance. The c.g.s. unit of work is the erg.

**Wort.** A liquid produced by the mashing of cereal grains with malt. It consists of maltose, isomaltose, dextrans, peptones, and amides. Enzymes derived from the malt are also present in many cases.

## X.

**Xanthine.** A purine derivative, parent of a number of important compounds, constituted and numbered as follows:



**Xanthine Bases.** A number of proximate principles of plants, formerly classed as alkaloids, and some products of the animal economy derived from xanthine, as caffein, theobromine, theophylline, heteroxanthine, paraxanthine.

**Xanthates.** Salts of xanthic or ethyloxydithiocarbonic acid,  $\text{HS.CS.OC}_2\text{H}_5$ .

**Xantho-.** A prefix which indicates a yellow color, as xanthoproteic reaction.

**Xenon.** Gaseous element. Xe. At. Wt. 130.2. S. G. 63.5 (H = 1). M. P.  $-140^\circ$ . B. P.  $-109^\circ$ . Liquid xenon, S. G. 3.52. Critical temperature  $15^\circ$ . One of the rare gases of the atmosphere. Forms no known compounds.

**Xylyl.** The univalent radical  $\text{CH}_3\text{.C}_6\text{H}_4\text{.CH}_2\text{—}$  derived from xylene. It exists in three isomeric forms according to the relative positions of the methyl and methylene groups.

**Xylylene.** The divalent radical  $\text{C}_6\text{H}_4(\text{CH}_2)_2\text{:}$  derived from xylene. Three isomeric forms are known corresponding to the three xylenes.

## Y.

**Yard.** A unit of length in the English system. The U. S. standard yard is the 3600/3937 part of the international meter and is slightly longer than the English legal standard.

	1 yard	= 0.9144 meter.
1.0936	"	= 1.0000 "
1 cubic	"	= 0.7645 cubic meter.
1.3079	"	= 1.0000 " "

**Yeasts.** (Blastomycetes, saccharomycetes.) Unicellular microorganisms characterized essentially by their method of multiplication, by budding. They are classed with the non-chlorophyll containing fungi. The genus *saccharomyces* includes practically all of the yeasts of economic importance. *S. cerevisiae* is the special beer ferment; *S. ellipsoideus*, the wine ferment. Yeasts are grouped as Top Yeasts, which are carried to the surface of the vat by the carbon dioxide they pro-

duce, and Bottom Yeasts, which remain on the bottom of the vat and act at lower temperature than the top yeasts. Compressed Yeasts are made by collecting the yeast plants by filtration, mixing with 25 to 50% of starch and pressing. Wild Yeasts are yeast plants about which little is known and which are detrimental in their actions.

**Ytterbic.** A salt of ytterbium.

**Ytterbium.** (Neoytterbium.) Metallic element. Yb. At. Wt. 173.5. Valence 3. Oxide  $Yb_2O_3$ . Ore, gadolinite.

**Yttric.** } Containing yttrium; a  
**Yttrious.** } salt of yttrium.

**Yttrium.** Metallic element. Yt. At. Wt. 89.33. S. G. 3.80. Valence 3. Oxide  $Yt_2O_3$ . Ore gadolinite. The symbol for yttrium is sometimes given as Y.

## Z.

**Zeeman Effect.** (Zeeman phenomenon.) An alteration of the lines in the spectrum produced by subjecting the source of light (e.g. a flame colored by a volatile compound) to a powerful magnetic field. Observed through a spectroscope in a direction at right angles to the magnetic force single lines appear divided into three. The new lines are plane polarized, the central lines vibrating at right angles to and the outer ones parallel to the length.

**Zero, Absolute.**  $-273.1^{\circ}$  C. See thermometric scales.

**Zinc.** Metallic element. Zn. At. Wt. 65.37. S. G. 7.142. S. heat 0.09356. M. P.  $419^{\circ}$ . B. P.  $918^{\circ}$ . Valence 2. Ores, franklinite, hydrozincite, galinite, etc. Oxides,  $\text{ZnO}$ ,  $\text{ZnO}_2$ .

**Zincic.** A salt of zinc.

**Zinco-.** } Pertaining to or contain-  
**Zincous.** } ing zinc.

**Zirco.** Containing zirconium.

**Zirconic.** A salt of zirconium.

**Zirconium.** Metallic element. Zr. At. Wt. 90.6. Exists in two allotropic forms: amorphous, S. G. 4.15, M. P.  $1500^{\circ}$ , and crystalline, S. G. 5.3, S. heat 0.066. Ore, zircon. Oxides  $\text{ZrO}_2$ ,  $\text{Zr}_2\text{O}_3$ . Valence 4.

**Zircono.** Pertaining to or containing zirconium.

**Zyme.** A ferment.

**Zymic.** Produced by enzyme action.

**Zymo-Exciters.** (Accelerators.) Substances which stimulate the enzymes to increased activity, e.g. traces of manganese increase the activity of laccase. The term co-enzyme should be restricted to those substances without which the enzyme cannot act, as calcium which influences thrombin.

**Zymogens.** The progenitors of the enzymes in the organism; the substances from which the enzymes are supposed to be formed, as pepsin from pepsinogen, trypsin from trypsinogen, or thrombin from prothrombin.

**Zymohydrolysis.** Hydrolysis catalyzed by an enzyme.

**Zymurgy.** The chemistry of fermentation.

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